THE

AMERICAN GAS-LIGHT JOURNAL

DEVOTED TO

LIGHT, WATER, AND SEWERAGE.

JOHN B. MURRAY, BANKER, NEW-YORK CITY, PROPRIETOR.

Iron Buildings, No. 254 Canal Street, East, (cor. Elm Street,) near Broadway.

FIRST YEAR.—No. 9. NEW-YORK, THURSDAY, MARCH 1, 1860. $3 PER ANNUM.

TO GAS-FITTERS AND PLUMBERS.

L. WAEFELER & CO., No. 94 BEEKMAN STREET, New York, have always on hand several hundred kegs WROUGHT-IRON GAS-PIPE HOOKS, of all sizes from ⅛ to 2 inches. They are made of best quality horse-shoe nail iron, and warranted not to break.

Also, PLUMBERS' MATERIALS, such as China Wash-Basins, Closet-Basins, Pan-Closets, Bath Tubs, Boilers, Brass and Silver-plated Cocks, Brass and Iron Pumps, Hydraulic Rams, French Fountain Jets, &c., all at the very lowest prices.

Butts & Kendall,

(FORMERLY F. BUTTS & CO.,)

Dealers in

STERLING COAL,

Cleveland, Ohio.

The attention of Gas Companies is called to the following letters as to the merits of the above Coal, being a few of the many we have received, and from which we are led to believe that there is no English or American Coal which combines all the qualities desired in a Gas Coal as perfectly as the Sterling :—

Office of the Manhattan Gas Light Co.,
Irving Place, corner East 15th Street,
New York, January 13, 1860.

MESSRS. BUTTS & KENDALL :—*Gentlemen* :—Yours of 9th inst. is received. The "Sterling Coal" received from you during the past year worked very satisfactorily—averaging 9520 cubic feet of 15 candle Gas per ton of 2240 lbs, and 41 bushels of Coke, weighing 1465 lbs.

We consider it among the best of American Gas Coals, for the quantity and quality of the Gas produced, and also for the excellent quality of its Coke. I am, Gentlemen, your obedient servant,

CHARLES ROOME, President.

Office of the Rondout and Kingston Gas Light Co.,
Rondout, January 4, 1860.

MESSRS. BUTTS & KENDALL :—*Gentlemen* :—The 600 tons of Sterling Coal ordered from you in August, 1859, has now been in use over four months, to my entire satisfaction. Its average yield is 4, 40-100 feet, and a good strong light. The Coke produced equal in quality and quantity, to best English Caking Coals. It burns very freely with little clinker. In purification it is economical, using no more lime than New Pelton. It is superior to any American Coal I ever used. I shall be pleased to give you any further information at my office in New York. WM. W. HAGUE, 522 Broadway

The Cleveland Gas Light and Coke Co.,
Office, 195 *Superior Street*,
Cleveland, December 30, 1859.

MESSRS. BUTTS & KENDALL :—*Gentlemen* :—This Company has used between 3000 and 4000 tons of your "Sterling Coal," and are still using it with very satisfactory results. We find the average product of a ton of 2000 lbs. is about 8800 feet of Gas and about 37 bushels of Coke. The Gas is of good illuminating power and quite free from sulphur or other impurities, one bushel of lime purifying 9000 feet, and the Coke of very superior quality. The yield of Gas is about the same as from the Pittsburgh Coal, and the Coke better adapted to our use. Yours, truly, T. DWIGHT EELLS, Sec.

Office of the Sandusky Gas Co.,
Sandusky, Jan. 16, 1860.

MESSRS. BUTTS & KENDALL:—*Gentlemen:*—This Company has used your Sterling Coal since July 3d, 1859, and are still continuing the use of it with satisfaction to the Company and consumers. The average product has been 8,629 feet of Gas per ton of 2,000 lbs, and 37 bushels of Coke of very superior quality. The Gas is as good as that obtained from Pittsburgh Coal. I consider it the best Coal ever used in our works. I am, gentlemen, yours respectfully,

WM HUDSON, Sup't and Sec'y.

We would also refer to Gas Companies in the following places :—New York City (Manhattan and New York Co.'s), Albany, Troy, West Troy, Rochester, Oswego, Rondout, Kingston, Albion, Brockport, Seneca Falls, Elmira and Lyons, in the State of New York ; Cleveland, Toledo, Sandusky, Norwalk and Oberlin, in Ohio ; Detroit, Ann Arbor, Grand Rapids and Kalamazoo, in Michigan ; Coburg, in Canada, and two Companies in Milwaukie, Wisconsin.

The extensive Mines of the Sterling Coal and Mining Company, in the western part of Pennsylvania (known as the Sterling Hills, and the highest in that part of the State), are wholly under our control, and the Coal is mined and sold only by us or our Agents. The average product of the Sterling Coal, per ton of 2,000 lbs., is 8,733 feet of 15¼ candle Gas (4, 37-100 per lb.), and 37 bushels of Coke of very superior quality. Getting our Coal to this place by railroad, a supply can be had during the summer months (as well as at all other times), which is not the case with coals dependent upon high water for transportation, as are most or all other gas coals which are sent to the Lake ports for shipment. Our mining facilities are such, that we are prepared to ship extensively. For any further information address the undersigned, or M. BALLARD, Esq., Syracuse, N. Y., who is our Agent for that State.

BUTTS & KENDALL, Cleveland, Ohio.

CORNELIUS & BAKER,

MANUFACTURERS OF

LAMPS, CHANDELIERS,

GAS-FIXTURES, &c.

MANUFACTORIES,

821 CHERRY STREET,

AND

FIFTH STREET AND COLUMBIA AVENUE.

STORE, 710 CHESNUT STREET,

PHILADELPHIA.

LAND IN CANADA FOR GAS-LIGHT SHARES.

Town of Coburg,	Northumberland Co	14	acres.
Do Hamilton,	do do	100	"
Do North Monaghan,	Peterborough do	600	"
Do South do	do do	100	"
Do Dummer,	do do	100	"
Do Douro,	do do	223	"
Do Haldimond,	Northumberland do	200	"

These lands are well located, and will be exchanged on equitable terms for sound, dividend paying gas-light shares in the United States or British Provinces.

Apply or address E. R. L., Post-Office, Toronto, Canada, or at Rooms of AMERICAN GAS-LIGHT JOURNAL, New York.

CLAY RETORTS.

J. K. BRICK & CO.

BROOKLYN CLAY RETORT AND FIRE-BRICK Works, Van Dyke, near Van Brunt street, Brooklyn, N. Y.—J. K. BRICK & CO., manufacturers of Non-Filtrating Clay Retorts, Fire Brick, Gas and Hot House Tiles, Arch, Furnace and Cupola Brick, Fire Cement, Mortar, &c.

J. K. B. & Co., have, at their extensive works, facilities for manufacturing, which enable them to supply gas companies and others with any amount of their goods, at short notice.

Particular attention is invited to their superior Clay-Retorts, which are giving perfect and universal satisfaction to the numerous gas companies who have them in practical operation.

They refer parties interested to the Brooklyn, N. Y., Gas-Light Works, where can be seen more than two hundred in daily use.

To Messrs. BOUSQUET, CHAMPENOIS & Co., Clay Retort Manufacturers.

I await your reply to my letter of the 6th instant, since which I have set in action a bench of seven retorts, according to your instructions, and the success has been complete. Your Retorts have not the smallest crack or fissure, although in contact with the fuel. I am all the more satisfied and surprised at this, inasmuch as of all my old Retorts, both Belgian and English, not one has been able to resist the first kindling of the fuel without cracking.

Indeed, the English Retorts fall in pieces, notwithstanding all the imaginable care, and lately they have done this, even when heated up according to your instructions.

Allow me to congratulate you on having solved the most difficult problem, and on your success in rendering Clay Retorts of real value in Gas-Works. Respectfully yours,

AUG. REBUFFET,
Director of the Genoa Gas-Light Co.

Genoa, 11th November, 1857.

We can add nothing to this letter except the fact that we fully endorse the certificate given above to Messrs. Champenois & Co., as far as regards the whole of the Retorts in use in our works and in those of our friends.—*Journal de l'Eclairage au Gas.*

Trieste, April 25th, 1857.

To Mr. CHAMPENOIS :—I employ some of your Retorts, and cannot but express my satisfaction. *I prefer them of all those I have tried.* Therefore neglecting not all the advantages resulting from the use of the same, send me a plan or drawing of a bench of seven Retorts, according to the instructions of *Le Journal de l'Eclairage au Gas.* Address to Mr. E. Vermarre, Mars filles, who will soon send me some more of your retorts. Respectfully yours,

ALFRED GOTTEROUE,
Engr. of Trieste Gas Works, Dalmatia, Austria.

The Clay Retort Works of J. K. Brick & Co. having been organized under my superintendence, the certificate above may be applied as well to the Clay Retorts manufactured in Brooklyn ; they being in operation at the Brooklyn, Harlem, Syracuse, Hempstead, and many other Gas-Works, where the result is identically the same. In Brooklyn they are set without any tiles, therefore are in direct contact with the fuel.

Brooklyn, N. Y., February 21st, 1860.

(Signed,) H. CHAMPENOIS.

MARSH'S PATENT ROSIN OR SUN-LIGHT GAS-Works, for Private Dwellings, Hotels, Factories, Railway stations, Sugar-Houses, Towns, &c. By the peculiar construction of the Retorts, the largest amount of decomposing surface is obtained in the smallest space. 2d. Gas is manufactured from crude rosin, without the least deposit of carbonaceous matter in the retorts or pipes : thus enabling them to be operated continuously, generating rapidly the best and cheapest illuminating gas obtained from this material. ALFRED MARSH & CO.,
241 Broadway, New York.

AMERICAN GAS-COALS.

JOHN HEARN & CO., ERIE, PA.,

DEALERS IN BITUMINOUS COALS FOR GAS, Steam and House use.

We are now prepared to contract for the delivery of any quantity of our Coals at all points accessible to vessels on the NORTH-WESTERN LAKES, and also at all places on the ERIE CANAL and HUDSON RIVER, or points in the interior connected by Rail Road with the water communications mentioned.

The following are a few of the Gas-Light Companies who have used our Coals—entirely or in part—for the past ten years, which we deem a sufficient guarantee as to their quality, and to whom we would refer, viz :

Manhattan Gas-Light Co., N. Y City, Albany N. Y., Gas-Light Co ,
Troy, N. Y., Gas-Light Co., Utica, N. Y., Gas-Light Co.,
Syracuse, N. Y., Gas-Light Co., Buffalo, N. Y., Gas Light Co.,
Rochester, N. Y., Gas-Light Co., Chicago, Ill., Gas-Light Co.

For the information of Gas-Light Companies generally, we have obtained from the Manhattan Gas-Light Co. of New York City, an analysis of the several varieties of Coal named below, from which we think an estimate of their relative value can readily be made.

	Mount Carbon, Pa.	Cooper's Beaver, Pa.	Pitt'gh & Youghiogheny, or Westmoreland	South Pe'th, Newcastle Eng.*
Feet of Gas per ton of 2240 lbs.	9.676	9.900	10.281	9.184
Bushels of Coke	48	42	42	53
No. of pounds	1488	1388	1480	1768
Illuminating power of Gas	12.49	15.46	13.99	12.2
F't purified per bush. hydrate lime	3.000	3500	2500	3500
Analysis of Gas.				
Olefiant Gas	5.77	*	5.50	
Hydro-Carbon vapors	1.23		0.00	
Carbonic Oxyde	11.88		8.00	
Analysis of Coal.				
Volatile Matter	42.75	41.50	38.15	30.83
Fixed Carbon	55.15	52.40	56.70	67.17
Ash	2.10	6.10	5.15	2.00

(*) Analysis of Gas not given.

JOS. A. SABBATON, ESQ., Engineer of the Manhattan Gas-Light Company above named, says "the coke from the Mt. Carbon Coal is clean and makes a hot fire. The coke from the Westmoreland or Pittsburgh and Youghiogheny Coal, is similar to the coke from the best Newcastle, though somewhat inferior in quality. The quantity of Gas purified by a bushel of lime, varies so much in different works, according to the amount of washing, condensation, and lime surface, that the above figures, so far as the purification is concerned, must be taken as the results obtained in the laboratory in which the examinations were conducted."

The Mount Carbon Coal, for Gas purposes, considering the yield of Gas and Coke, and on account of its being comparatively free from sulphur and all other impurities, has no superior as an American Coal. The Buffalo, N. Y., Gas-Light Company, O. G. Steel, Secretary and Superintendent, says :

"The Mount Carbon Coal, which we used last year (1858) for the first time, proved to be of excellent quality, giving a satisfactory yield of Gas and Coke, both in quantity and quality. We shall be satisfied with coal of that quality for the coming year."

The Rochester, N. Y., Gas-Light Company, George W. Parsons, Supt., who used Mt. Carbon and Beaver Coal, writes : "It affords us pleasure to say that the Coal furnished by you to our Company the last season, (1858) consisting of Beaver and Mount Carbon in nearly equal proportions, has proved in all respects as good as represented, and has given a better average yield of Gas than we have had in any previous year. The Gas is easily purified, and the quality, as well as quantity, of Coke and Gas, is equal to the product of any Coal which has been furnished us."

The Syracuse, N. Y., Gas-Light Company, L. W. Conkey, Supt., writes us, Dec. 25, 1858—"We have been making Gas for the past two or three months, of the new Coals purchased of you this last season, mixed one-third Beaver and two-thirds Mount Carbon, and must say that it is the best Coal we have had since our works first started, yielding an average of more than four feet of Gas to the pound of Coal every day in the month."

Similar testimonials could be given from other Gas establishments who have used these Coals, but these are sufficient to show the estimate in which they are held. They have no superior for Steam or Household use. We are also prepared to contract for the delivery of Pittsburgh and Youghiogheny Coal, at low rates.

J. HEARN & CO, Erie, Pa.

J. H. BRUNDAGE & CO.,

38 BURLING SLIP, NEW YORK, DEALERS IN

ROSINS ADAPTED ESPECIALLY TO GASMAKERS' USE.

N. B.—J. H. B. & CO. ARE CONSTANTLY PURCHASERS OF ROSIN-GAS TAR.

ADDISON POTTER,
WILLINGTON QUAY,
NEAR NEWCASTLE-UPON-TYNE, ENGLAND,
Manufacturer of CLAY RETORTS, FIRE BRICKS, and every description of FIRE CLAY GOODS.

TO GAS-COMPANIES, ENGINEERS, Merchants Gas-Fitters, Surgical Instrument Makers, &c

FLEXIBLE GAS FITTINGS.

The existing great demand for Hancock's ENAMELLED or GLAZED FLEXIBLE TUBING, and the increased facilities of manufacturing it is an assurance of the satisfaction experienced by the public in the use of this article, so extensively made by JAMES LYNE HANCOCK, OF LONDON, who begs now to announce to the trade, that he continues to export, to a large extent, FLEXIBLE GLAZED TUBING for GAS, Surgical and other instruments, now in such general use amongst Gas Companies, Engineers, Gas-fitters and others.

This is the only TUBING that perfectly resists the action of coal gas. It is made of all sizes, from ⅛ inch up to 1¼ inches, and in 60 feet lengths. The measure is always external diameter, to connect the usual metal fittings.

SOLID VULCANIZED INDIA RUBBER TUBING, for GAS, WATER, &c., made of all sizes, and in 60 feet lengths, either with or without spiral wire inside.

For price lists and any other information, apply to JAMES LYNE HANCOCK, VULCANIZED India Rubber Works, 8 Goswell Road (opposite Spencer street), LONDON, E. C.

N. B.—Orders by post, with remittance, or good reference in England will be promptly executed.

MOST IMPORTANT TO ALL Consumers of Gas.

HART'S PATENT GAS-BURNER.

HART'S PATENT ECONOMIZING GAS BURNERS have been adopted by thousands of public and private establishments, Gas Companies, for Street Lamps, &c., &c., in various parts of Europe, after proving the utter WORTHLESSNESS of GAS REGULATORS and other inventions ALLEGING to produce a MAXIMUM amount of light with a MINIMUM amount of gas, and are considered by all who have given them a trial to be the most economical—effecting a positive saving of from 5 to 35 per cent.—and the only means capable of producing a WHITE, THIN AND PURE FLAME of such brilliancy as was never before obtained from gas by whatever means consumed, as proved by photometrical tests made with the most improved instruments by Bunsen, Wheatstone, King, and Wright, *the superior light varying in degree from 5 to 100 per cent.* This invention, patented by Mr. HART (of Fleet street, London), in England, France, Belgium and other foreign parts, is now being universally adopted, and will doubtless continue to be so long as gas is used.

The principle of the invention consists in the gas being (in its passage through the burner) resisted primarily by a FIBROUS MATERIAL, thence passing through a diaphragm of felt encased in two perforated metallic discs, so that the pressure with which the gas is supplied from the mains becomes checked, and permits the gas to reach the orifice of the burner with only such velocity as may be requisite to develope a FULL AND BRILLIANT FLAME while perfect combustion is simultaneously secured, and thus is prevented the escape of unconsumed gases which so deteriorate the atmosphere as to produce a most injurious effect upon the health, and are alike destructive of works of art.

HERBERT WILLIAM HART,
69 Fleet street, London.
Or care of AMERICAN GAS-LIGHT JOURNAL, N. YORK.
(For engravings see AMERICAN GAS LIGHT JOURNAL for December, 1859, page 100.)

BY ROYAL LETTERS PATENT.

GEORGE ANDERSON, GAS ENGINEERING Offices, 104 Leadenhall st., London, E. C., Patentee of the Direct acting Piston Exhauster, &c., begs to draw the attention of the Engineers and Managers of American Gas-works to his Patent Purifying Changing or By-pass and Shut-off Valves.

COWEN'S PATENT FIRE-CLAY Retorts.

JOSEPH COWEN & Co., Blaydon Burn, near Newcastle-on-Tyne, England, were the only parties to whom a Prize Medal was awarded at the Great Exhibition in London, of 1851, for "GAS RETORTS AND OTHER OBJECTS IN FIRE CLAY."

J. C. & Co. have been for many years the most extensive manufacturers of Fire Clay Retorts in the United Kingdom; and orders for FIRE CLAY RETORTS of all shapes and dimensions, FIRE BRICKS, and every other article in Fire Clay, are promptly executed at their works as above.

COWEN'S GARESFIELD COAL AND COKE.
Coal and Coke office,
QUAY SIDE, NEWCASTLE ON-TYNE.

NATIONAL GAS APPARATUS.
GEORGE BOWER, Gas Engineer, and Contractor, ST. NEOTS, Huntingdonshire, England, Contractor for the erection of GAS-WORKS of any magnitude, and manufacturer of GAS-FITTINGS, METERS, REGULATORS, and all apparatus connected with the production and distribution of gas. Patentee of the following:

1st. Portable Cannel Coal Gas Apparatus, requiring neither skilled labor nor brickwork to fix, but complete in itself for 10, 20 and 30 lights; specially adapted for cannel coals which do not coke.

2d. Retorts fed and discharged by machinery, so that gas making by this apparatus is conducted without any nuisance whatever; adapted for 40 and 70 lights, and for cannel coal of Lancashire quality.

3d. Combined apparatus, forming in one vessel the HYDRAULIC MAIN, CONDENSER AND PURIFIER; adapted for all sized works, from 100 up to 500 lights, and any quality of coal may be used with these works.

The advertiser has patterns complete for all sizes up to 2,000 lights, and can forward orders expeditiously. He requires first-class houses to represent him in America, Canada, and the Brazils. All applications to be prepaid.

WILLIAM RYDER,
General Mineral and Metal Agent and Merchant, 4 Dean street, NEWCASTLE-ON-TYNE, England, is prepared to supply Gas Companies and others with every variety of appliance for the production and supply of Gas, including GASOMETERS, RETORTS (metal and clay), FIRE BRICKS, COALS, METAL MAINS, TUBES, in wrought iron, copper, brass, lead or composition, METERS, TAPS, FITTINGS, &c., &c.; and from his extensive experience in this class of work, can guarantee every thing of the best description.

JOHN MURRAY, Solicitor,
No 7 Whitehall Place, London.
Commissioner for the State of N. York.

Resident in London, England, to take affidavits, acknowledgements, depositions, &c., in London, under the act of the Legislature of the State of New York, passed April 17, 1858.

HARRIS & PEARSON,
PROPRIETORS OF
Best Glass-House Pot, and Crucible Clay.
MAKERS OF THE IMPROVED BOHEMIAN GLASS-HOUSE FURNACE.
AMBLECOTE FIRE CLAY BRICK WORKS, STOURBRIDGE, ENGLAND.
Manufacturers of Fire-Brick, Gas-Retorts, &c.

M'KENZIE & O'HARA,
Plumbers and Gas-Fitters, No. 326 FOURTH STREET, CORNER OF MERCER ST., NEW YORK.
Water Closet Pans, Wine Basins, Wash Basins, Sinks, Fountains, Jets for public and private purposes, Stop-cocks, Filters, and all other Water apparatus.
ALSO, a complete assortment of Gas-fixtures, Pendants, Chandeliers, Brackets, &c &c.

THOMAS NICHOLL, GAS AND Steam Fitter and Plumber, Nos. 170 and 172 Centre street (next door to N.Y. Gas Co.'s office), New York. Pipes inserted in Churches, Factories and Dwellings; Chandeliers re-gilt.
Jobbing promptly attended to.

HUNTER, KELLER & CO.,
Manufacturers of
WROUGHT-IRON PIPES, AND FIXTURES
of all descriptions, for
STEAM, WATER AND GAS,
144 Centre street, New York.

STUART & PETERSON,
Willow street, above Thirteenth, Philadelphia, Manufacturers of LAMP POSTS and CAST IRON STREET-LANTERNS.
P. S.—Our Cast Iron Lanterns are warranted to outlast three Tin Lanterns.

HARPER & O'CONNELL, Manufacturers of Gas Shades and Globes of every description. FRENCH COLORED GAS SHADES AND SMOKE BELLS. Nos. 63 and 65 Elizabeth street, corner Hester, New York.

TRANER, JONES & CO.,
117 North Water street, and 124 North wharves, Philadelphia, AGENTS FOR FLORENCE & MERCER FOUNDRIES, ELK STREET IRON WORKS.
CAST IRON STREET MAINS; *Bends, Branches, Chemical Retorts, and all kinds of Castings for* GAS-WORKS, either COAL or ROSIN WORKS. SHEET IRON FOR GASOMETERS *cut and punched to order.* BOILER IRON *of all descriptions.* RUSSIA SHEET IRON, TIN PLATES, BLOCK TIN, COPPER, PIG LEAD, SPELTER, and Metals generally.

I AM PREPARED to furnish, at my Balloon Factory at this place, Balloons complete and ready for service, manageable by ordinarily skillful persons, at reasonable prices. For a Balloon of fine linen, large enough to carry two men, ready to ascend, the price will be $250. Other sizes in proportion. My Balloon Linen is made to my own order in Europe.

List of prices of Balloons, all complete for use.

Feet. Diameter.	Lifting power with coal gas.	Prices.
25	220	$200 00
26	225	210 00
27	290	220 00
28	325	235 00
29	360	250 00
32	500	300 00
40	1020	400 00

At these prices I can furnish good serviceable Balloons, which are easily managed, will make hundreds of ascensions, and which an ordinary person may use with as much success as he can a horse and buggy.

JOHN WISE, Lancaster, Pa.

WEST TROY, (N. Y.,) IRON FOUNDRY.
AUGUSTUS VIELE, Manufacturer of Gas and Water Pipes of all sizes. DRIPS, SYPHONS, BENDS, AND BRANCHES. The manufactures of this establishment are in use in various Gas and Water Works throughout the country.
Address AUGUSTUS VIELE, West Troy, N. Y.

F. A. SABBATON, ALBANY, N. Y., Gas Engineer and Contractor.
COAL AND ROSIN WORKS of any capacity constructed on the most approved plans.
Refers to CHARLES ROOME, ESQ., Prest. Manhattan Gas-Light Co., N. Y.; R. PUMPELLY, ESQ., Prest. Albany, N. Y., Gas-Light Co.,; J. K. BRICK, ESQ., Engineer Brooklyn N.Y., Gas Co.

E. A. COEN, ENGINEER AND Contractor, for Coal Gas Works.
Plans and specifications furnished and Works erected for cities, towns and villages ROSIN WORKS altered and repaired. Pipe, &c., furnished and laid for Water and Gas.
E. A. COEN, Rondout, Ulster Co., N. Y.

STEPHEN SCAMMON,
Gas Engineer and Contractor for the erection of Gas-Works; also, dealer in CAST and WROUGHT IRON PIPE for Steam, Water and Gas, No. 561 Broadway, New York.

DARDONVILLE, Importer of Paris Bronzes, Gas-Fixtures, Carcel Lamps, &c. French Rape Seed Oil for sale. No. 623 Broadway, New York.

JAMES HELME,
Chandelier and Gas-Fitting Establishment, No. 58, East Thirteenth street, between Broadway and University Place, New York.

GEORGE W. KRAFT, GASOMETER and Boiler-maker, Chestnut st. wharf, West Philadelphia, manufactures Gasometers, Retort House Roofs, Water Tanks Purifying Boxes, Coal Cars, Coke Barrows, and all kinds of Wrought Iron Work for Bridges, Buildings, &c.
Particular attention paid to Alterations and Repairs.

REFERENCES:
John C. Cresson, Engineer Gas Works, Philadelphia; Joseph A. Sabbaton, Engineer Manhattan Gas Works, New York; Col W. S. Campbell, Engineer Gas Works New Orleans; P. A. Sabbaton, Engineer Gas Works, Albany; Waterhouse and Bowes, Gas Engineers, Raleigh, N. C.; Joseph Battin, Newark N. J.; C. B. Dungan, Philadela.

DANIEL THOMPSON,
Machinist and manufacturer of Stop Cocks, Fire Plugs, &c., for Water-Works, STOP COCKS, VALVES, DRIP PUMPS, &c., for Gas-Works, No 133, Elfreth Alley, Philadelphia.

HOPE IRON FOUNDRY, PROVIDENCE, R. I.
Gas-Work Castings of every description.
They would call attention to their superior IRON RETORTS, which are extensively used with good satisfaction; also to E. WALCOTT'S PATENT MOUTH and LID, possessing important advantages over any other in use, and are shown in a circular which can be obtained by addressing—
JOS. P. MANTON, Agt.

LE JOURNAL DE L'ECLAIRAGE AU GAZ, published in Paris on the 5th and 20th of each month.
American subscriptions are received at the Rooms of the AMERICAN GAS-LIGHT JOURNAL., N. Y.

IRON GAS AND WATER PIPE.
JOHN GILKISON & CO., No. 90 Beaver street, New York City, Agents for the largest Iron Founders in Scotland. They are prepared to make contracts for the supply of IRON PIPE from 2 to 48 inches in diameter, for delivery in the Spring. Every description of Castings made to order. Wire Rope, &c., &c.

A. BRONSON,
Pattern and Model Designer and Maker, having had twenty-five years' experience, will assist and perfect inventions and designs. PATTERNS and MODELS made of WOOD, IRON, or BRASS (secretly, if desired,) on short notice.
N. B.—Stove and machine patterns of every description, made with elegance and precision.
Metallic letters for patterns always on hand.
No. 102 Elm st., cor. Walker st., New York.

BERGEN IRON WORKS.
Established 1823.
R. A. BRICK, Manufacturer of CAST-IRON WATER and GAS PIPES. RETORTS PIPES, &c., always on hand. Office 109, Leonard street, New York.

GIRARD TUBE WORKS. MURPHY & ALLISON, Proprietors. Wrought Iron Coke-Welded Tubes, for Gas, Water, Steam, &c. Wrought, Cast and Malleable Iron Fittings, Steam and Gas Cocks, Valves. Also, Galvanized Tubes and Fittings.
Office 1908 Market street, Philadelphia.

COLWELL & CO., Manufacturers of Pig Iron and Cast Iron Gas and Water Pipes, No. 207 North Water street and 206 North Wharves, Philadelphia.
STEPHEN COLWELL, W. DWIGHT BELL,
THEO. TREWENDT, SAMUEL FULTON.

PATENT PYRO-CLAY GAS RETORTS. THOMAS HOADLEY, Patentee, wishes to call the attention of Gas-engineers to these Retorts, as a very superior article.
REFERENCES:—Gas-Light Works, Buffalo, N. Y.
" " Cleveland, O.
" " Detroit, Mich.
THOS. HOADLEY, 34 Front st., Cleveland, O.

ENGLISH FIRE BRICKS, Rufford's Stourbridge Bricks, Stourbridge and Welsh Clay.
S. THOMPSON'S Nephew, IMPORTER,
45 Gold street.

JOHN GILKISON & CO., 90 Beaver street, New York City, Importers of Fire-Clay Pipe, for Water and Sewer purposes, from 3 to 36 inches diameter, Fire Bricks, Vent and Linings, and all descriptions of Fire-Clay Manufactures.

JOHN NEWKUMET, Philadelphia Fire-Brick Works, Vine and Twenty-third Streets, Philadelphia.
Manufacturer of all kinds of FIRE-BRICK, GAS-HOUSE TILES, to suit all the different plans in use. Clay Retorts and Dentists' Muffles. Orders filled at short notice.

MANY, BALDWIN & MANY,
49 John Street, New York. Agents for Gautier's Clay Retorts, Fire and Arch Bricks, Gas-House Tiles, &c. Black Lead Crucibles for Steel Works and Brass Founders. A full assortment of Tiles and general Hardware.

T. G. ARNOLD, Manufacturer of Gas Burners, Mercury Cups, Portable Sockets, Burner Pillars, &c., No. 447 Broome street (second door west of Broadway), New-York Imported Scotch Tips and Burner Flyers always on hand

FRD. C. KRAUSE,
Manufacturer of Patent Porous Gas-Burners for COOKING, IRONING, HEATING, CHEMICAL APPARATUS, &c., No. 772 Eighth Avenue, corner of Fifty-Fourth street, New York.

HIGHLY GLAZED FIRE CLAY Pipes, for Sewerage and Water Purposes, Gas Retorts, Fire Bricks, &c WILLIAM McKEAN, 74 Broadway, New York, agent for the "Field House Fire Clay Works," Huddersfield, England, is prepared to treat with corporations, Contractors, and Gas Companies, &c., for the supply of the above articles, either in Liverpool, or delivered at any important port on the Atlantic coast, from New Orleans to Montreal. The Field-house Pipes have been used for the sewerage of the pridcipal cities and towns in England, and are now being extensively used for the sewerage of the city of Brooklyn, N. Y. They are impervious to moisture or decay; will stand great internal and external pressure, and are cheaper than either brick or stone sewers
Further information can be obtained by application to WILLIAM McKEAN, 74 Broadway.
Pipe Yard—Furman street, between Joralemon and Atlantic streets, Brooklyn.

TO GAS AND WATER COMPANIES:
The undersigned, Agent for Messrs. Thomas Edington & Sons, Phenix Foundry, Glasgow, Scotland, is prepared to contract for all descriptions of Cast-Iron Pipes of their manufacture.
About 6000 tons of these Pipes have lately been supplied to the Brooklyn Water-works, N. Y., and the Chief Engineer of the Works, A. P. Kirkwood, Esq., is ready to testify to their excellent quality.
ARCHIBALD BAXTER,
90 Broad street, New York,
Sole Agent for the United States and Canada.

THE AUBIN GAS-WORKS CO., (No. 44 State street, Albany, N. Y.,) will refer parties wanting GAS-WORKS FOR VILLAGES to seventeen of their Village Works now in operation in the United States and the Canadas in *every one of which the profits of the company are ten per cent. and upwards, and yet good gas is furnished.* Agents wanted to extend the sale of the AUBIN PORTABLE GAS STOVE for dwellings, factories, &c., which will make 1000 feet of gas in five hours, and with greater simplicity, safety and economy, than any other known apparatus.

GASOMETER RIVETS.
Every kind of Rivets used in Gasometers. PHILLIPS & ALLEN,
Pennsylvania avenue, above 22d st., Philadelphia

Office for the Inspection of Gas Meters,

FOR THE STATE OF NEW YORK.

AGENT FOR

Scammon's Celebrated Gas Apparatus,

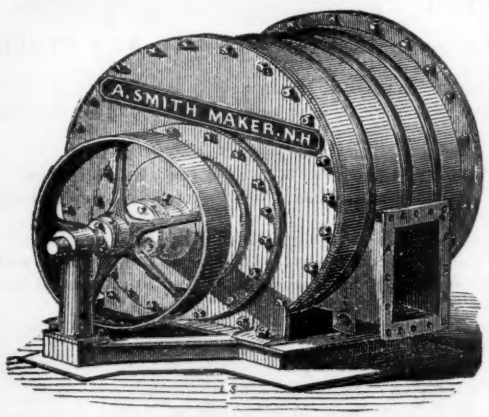
FOR EITHER COAL OR ROSIN GAS.

GAS-FIXTURES OF ALL DESCRIPTIONS.

GAS-FITTING.

GEORGE H. KITCHEN & CO.,

561 BROADWAY, NEW YORK.



THE ABOVE CUT REPRESENTS MACKENZIE'S PATENT GAS EXHAUSTER (Force Blast.)

It is offered to Gas Companies as a most perfect Machine. They are made of various sizes, capable of exhausting from 5,000 to 150,000 cubic feet per hour.

They require less power, work smoothly, are not so liable to get out of order, and cost much less than the imported ones.

Gas companies intending to use an exhauster, by stating the quantity of gas they may wish to have pass through per hour, will be furnished with a statement of the proper size, and the price of the same, on application to ADDISON SMITH, Manufacturer, New Haven, Conn., or to Messrs. ELLIMAN BROTHERS, New York.

The manufacturer has the liberty to refer to the Albany, N. Y., Gas Light Co., where one has been in constant operation for many months. Another one, capable of exhausting from 50,000 to 70,000 cubic feet per hour, will be in operation in a few weeks, at the St. Louis Mo., Gas-Works.

D. McDONALD & CO.,

No. 51 LANCASTER STREET, ALBANY, N. Y.

MANUFACTURER OF

Station Meters, Wet Meters (with Iron or Tin Cases,) Dry Meters, Fancy, Experimental and Show Meters, Gas-Holders for Testing Meters, Pressure Guages, &c., &c.

We wish to call the attention of Gas-Light Companies, Gas Engineers, and all others who contemplate the purchase of Gas Meters, to the fact that we are now manufacturing, and prepared to fill all orders in the above line upon terms as favorable as any other manufacturers in the country.

Having improved, simplified, and so far perfected the mechanical construction of our Meters as to render them unquestionably equal, if not superior to any others now in use, we can confidently offer them to purchasers as such. The extreme simplicity of our Dry Meters renders their wear and liability to get out of order, less than any other Meter in the market. First-class workmen only employed, and the best materials used. All work warranted. ☞ Meters sealed by the State Inspector, according to the laws of New York.

CANNEL and COAL

OF THE BEST DESCRIPTIONS

FOR MAKING GAS AND COKE.

ANALYSES OF CANNEL,

Showing, from the most recent tests, the productive power (in volume) of each kind of material.

	GAS. Per ton, 2240 lbs In Cubic Feet. At 60° temperature.	COKE. Per ton, 2240 lbs. Cwt.	Qrs.	Lbs.	Quality of Coke.	Ammonia Water in Gallons.	Tar in Gallons.	Illuminating power * per burner consuming 5 feet Gas per hour.	Price per ton free on board vessels in Liverpool	Price at $4.80 per £ sterling.
1	11,700	13	2	7	ood.	16	19	22.50	17s.	$4.08
2	11,000	13	1	16	"	18	16¼	21.25	15s. 6d.	3.72
3	10,000	11	2	0	Inferior.	25	15¼	20.00	14s.	3.36

ANALYSES OF COAL.

No.	GAS. Per ton, 2240 lbs In Cubic Feet.	COKE. Per ton, 2240 lbs. Cwt.	Qrs.	Lbs.	Quality of Coke.	Ammonia Water in Gallons.	Tar in Gallons.	Illuminating power * per burner consuming 5 feet Gas per hour.	Price per ton free on board vessels in Liverpool.	Price at $4.80 per £ sterling.
1	11,000	13	1	16	Good.	16	11⅛	14.00	11s. 6d.	$2.76
2	9,690	13	3	0	"	27	10	10.40	9s. 6d.	2.28
3	9,300	13	2	0	"	24	12	9.80	8s. 6d.	2.04

* Equal to Spermacetti Candles, burning 120 grs. per hour.

The above analyses embrace the best Cannel and Coal raised in the Lancashire, &c., districts, and are tabulated, for safety, rather below the average results. They are large, well screened, and free from dirt when delivered on board vessels, and are used for gas purposes at the chief gas works in England and on the Continent.

Orders for less than 50 tons, (*i. e.*, a boat load,) will be charged the cost of carting, viz., 1s. 6d. per ton.

The prices quoted will in all cases be subject to such alterations, more or less, as the case may be, as may arise in the market between the issue of this offer and the time at which the order may come to hand.

TERMS:—Cash, on presentation of the bills of lading at your bankers or agents in Liverpool, or as may be otherwise arranged, less 2½ per cent. discount

Also, HAND PICKED CANNEL and COAL, for house use.

Concessions in prices made for large quantities.

GAS APPARATUS of all descriptions and on the most approved principles. Also, Purifying and other materials supplied.

ANALYSES, PLANS, and ESTIMATES, and other information required, and the highest references, furnished on application.

Contracts for materials and works entered into. No charge made for superintending shipments, preparing bills of lading, or passing entries.

EMANUEL TURNER & CO.,

Export Offices, 34 Castle street, Liverpool, England.

FIRE CLAY GAS-RETORTS.

PERCETON FIRE-CLAY WORKS,

KILMARNOCK, SCOTLAND.

☞ **THESE** Retorts stand unrivaled, and are adopted invariably by the BRITISH GOVERNMENT in all their Works. They are rengered unusually smooth and free from cracks, thus preventing leakage and the adhesion of Carbon to the interior.

JOHN GILKISON & CO.,

90 BEAVER ST., NEW YORK CITY, *Sole Agents for the United States and Canada.*

CELLULAR GAS RETORTS. C. M. CRESSON'S CELLULAR GAS Retorts, Patented October 3d, 1854. Adapted to the manufacture of GAS from Rosin, Coal, Wood, &c., and now in use at the Philadelphia Gas Works. Patent Rights for sale. For information apply to HENRY S. HAGERT, Attorney for Patentee, S. E. cor. of Walnut and Sixth streets, Philadelphia, Pa.

ALFRED F. JAMES, Collection, Exchange and Land Agency, Galveston, Texas.

REFERENCE—John B. Murray, New York.

R. D. WOOD & CO., Manufacturers of Cast Iron, Gas and WATER PIPE; RETORTS, LAMP-POSTS, &c. S. W. corner 4th and Chesnut streets, Philadelphia. Works at Millville, N. J.

LOCKE & CRAIGIE, Plumbers and Gas-Fitters, No. 12 East 20th street, New York.

LOCKE, CRAIGIE & CO., Gas-Fittings, Chandeliers, Brackets, Globes, &c., No. 937 Broadway, New York.

☞ Particular attention paid to country work.

MORRIS, TASKER & CO., PASCAL IRON WORKS, [ESTABLISHED 1821.]

PHILADELPHIA, manufacture Wrought Iron Welded Tubes for Gas, Steam or Water; Lap Welded Boiler Flues,

GALVANIZED WROUGHT IRON TUBES,

ARTESIAN WELL PIPES,

of Wrought or Cast Iron, screwed together, flush inside and out; Gas-works Castings, Retorts and Bench Castings for Coal gas works; Cast Iron Street Mains, Sends, Branches, Drips, &c.

GAS AND STEAM FITTERS' TOOLS, &C.

STEPHEN MORRIS, CHAS. WHEELER,
THOMAS S. TASKER, STEPHEN P. M. TASKER,

MANHATTAN SAVINGS INSTITUTION, No. 644 Broadway, New York. Assets, January 1st, 1859, $1,183,609 98. Open daily from 9 A.M., to 7 P.M.

A. A. ALVORD, Secy. E. J. BROWN, Prest.

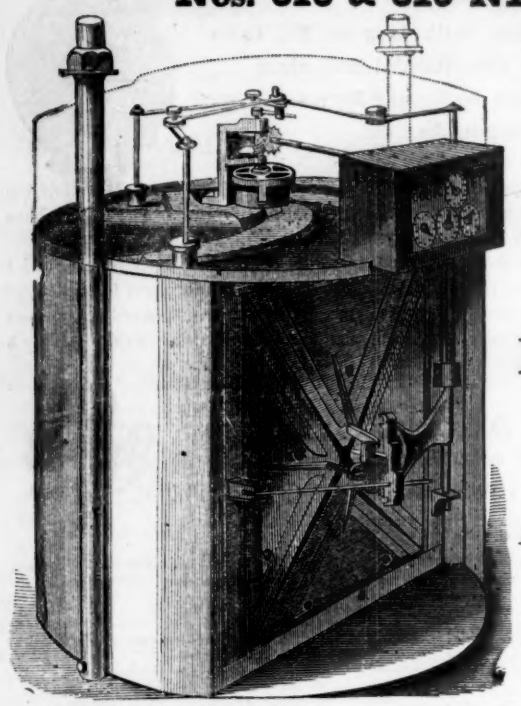
D. APPLETON & CO., Importers and Dealers in American and Foreign Books, publishers of Appleton's Railway Guide and of Appleton's Dictionary of Mechanics—a work indispensable to all engaged in the manufacture of Gas. 346 Broadway, New York.

JONES & LENNIG,

Nos. 313 & 315 NEW MARKET STREET, above Vine street,

Philadelphia, Pa.,

Invite particular attention to their



Patent Excelsior

ROTARY VALVE,

And Patent

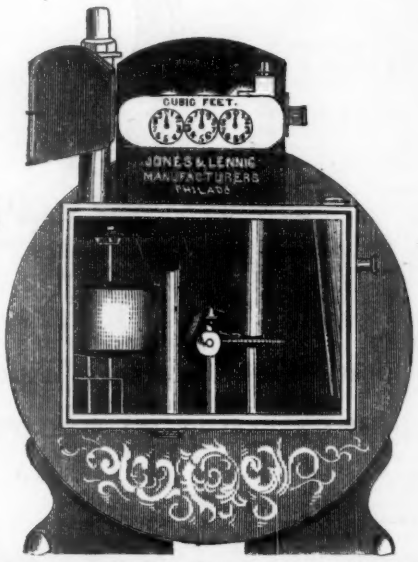
INLET CONDENSING CHAMBER

DRY GAS-METER,

And to their

UNSURPASSED

WET GAS-METER.



Both of which are certified, by experienced Gas Engineers, Builders and Superintendents of Gas works to be equal, if not SUPERIOR TO ANY OTHER METERS MADE.

We challenge investigation from whatever source, and DEFY EGOTISTICAL ATTEMPTS TO CRUSH FAIR AND HONORABLE COMPETITION.

Our drums weigh, invariably, from 2 lbs. 7 oz. to 2 lbs. 11 oz. and in point of material and workmanship we guarantee them to be *second to none in the country.*

Read the following Certificate from an old and experienced Gas meter manufacturer and inspector:

Philadelphia, December 1*st*, 1859.

Messrs. JONES & LENNIG,—GENTLEMEN :—As you requested, I took apart your three-light wet Gas Meter, and find it to be a *very fair* sample of *materials and workmanship;* the different parts are made and put together in a *workmanlike* manner, and will *compare favorably* with meters of other makers, and find the whole meter to weigh 10 lbs., 9 oz. and the drum to weigh 2 lbs., 7½ oz. The Drum Metal is No. 25, by the wire guage.

Yours Respectfully, GEORGE ELLIOTT.

This Meter was taken indiscriminately from a stored lot, and *not got up for the purpose.* Mr. Elliott gave the above certificate free of bias and influence; and his extensive and practical knowledge of Meter-making, entitles it to merit and confidence. We also placed the meter in the hands of Mr. Elliot, by *request* of one of the Board of Directors of City Works. Meters for use in New York will be sealed by the Inspector of that State.

MEDALS AWARDED TO THOMAS GLOVER'S PATENT DRY GAS-METERS.

MANUFACTORIES

SUFFOLK ST. CLERKENWELL GREEN. & ALLEN ST. GOSWELL ST. LONDON.

THOMAS GLOVER introduced his PATENT DRY GAS METERS into the United States and Canadas in 1846, and since that time he has received extensive patronage from many Gas Companies of those countries as well as from this. Thomas Glover confines his sole attention to the business of Gas-Meter making. The propriety of his doing so is satisfactorily proved by his success. For example: one London Company has now in use above 12,500 of his Patent Dry Gas-Meters, and some of these Meters have been fixed for fourteen years and are still in working order, without complaint from either the company or the consumer.

THOMAS GLOVER thinks it necessary to put Gas Companies on their guard against parties selling Patent Dry Gas-Meters constructed in imitation of his, but unskilfully made on erroneous principles, and with improper and unsuitable materials.

THOMAS GLOVER'S Workshops are now the most extensive in this or any other country, and he is thereby enabled promptly to execute orders to any extent required. Purchasers may, at any time, inspect his Works and the materials of which his Meters are constructed.

Suffolk Street, Clerkenwell, London, and 1 Barrett Street, Fulton Street, Boston.

JOHN ROGERSON & CO., New-Castle on-tyne & Middlesbro'-on-Tees, London, supply Gas Coal, Clay Retorts, Cast Iron Pipes and Retorts, Gasometers, &c. A partner of the above house being now in this city, will be glad to wait upon any gas company requiring supplies. Agents, MEAD & BELL, 17 William street, New York.

GAS-COAL.—PENN COAL CO.— The Penn Coal Company having completed arrangements for mining and shipping coal on an extensive scale, are now prepared to receive orders. The mines are favorably located on the line of the Pennsylvania Rai road, 26 miles east of Pittsburgh, Pa. The coal has been tested by many gas works, and the highest testimonials will be furnished. Communications addressed to Mr. A. L Massey, Philadelphia, will have immediate attention

GROVER & BAKER'S celebrated Noiseless Sewing Machines, at greatly reduced prices, No. 405 Broadway, New York.

THE WILLCOX & GIBBS' FAMI-ly Sewing Machines. The best family machine in the market, prices from $30 to $50. 504 Broadway, New York.

NORRIS & GREGG,

DEALERS IN WROUGHT IRON Pipe, and Manufacturers of Fittings for Steam, Gas, and Water, Nos. 62 and 64 Gold street, (between Beekman and Fulton streets,) New York.

THOMAS H. NORRIS. CHARLES GREGG.

WHEELER & WILSON'S Sewing Machines, No. 505 Broadway, New York. The very best in use. Send for a circular.

THOMAS DAY, No. 188 Mont-gomery street, near Jackson st., San Francisco, Cal.. Importer and Dealer in Gas Fixtures of every k nd and style, Gas Fittings, Gas-Hooks Service Cocks, &c., Iron Pipe, all sizes, for Gas, Water, or Steam.

DRAIN—PIPE. JAMES P. HAMMILL, Importer and dealer in best English FIRE-BRICK, FLOOR, MALT, AND ROOFING TILES, DRAIN PIPE, GAS PIPE, &c. 155 Water street, New York City.

DAVID JONES.

ORNAMENTAL JAPANNER, South-west corner of Ninth and Melon streets, Philadelphia, respectfully solicits a liberal share of patronage from the manufacturers of Gas-Meters and others He is prepared to execute all orders for Japanning promptly and reasonably.

Reference—Code, Hopper & Gratz, Gas-Meter Makers, Phila.

CLEGG'S TREATISE ON COAL-Gas Manufacture. third edition, with full instructions upon every detail incident to Gas-making, illustrated by engravings. A large supply has arrived. No gas company or engineer should be without it.

For sale at Rooms of the AMERICAN GAS-LIGHT JOURNAL, New York.

THE JOHNSON PATENT
GAS-BURNER AND REGULATOR
COMBINED.

FIG. 1.

FIG. 2.

FIG. 3.

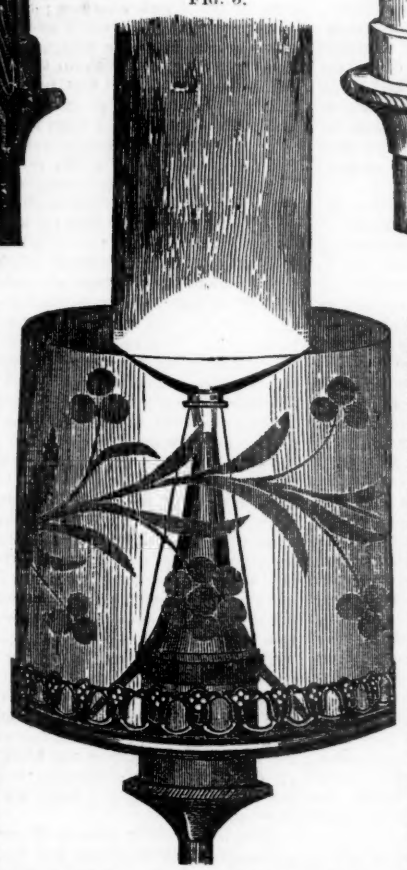


FIG. 1 of the annexed engraving is a sectional view of the Johnson Regulator and Burner.

FIG. 2 shows an elevation of the same.

FIG. 3 the same, equipped with spreader and glass shade, designed more especially for use where a perfectly steady light is indispensible, as in banks, offices, libraries, sewing rooms, &c., &c.

The constituents of Coal Gas are chiefly Hydrogen and Carbon. Its illuminating power is directly proportionate to the amount of Carbon contained in a given volume. Hydrogen is the lightest and most inflammable of all known bodies, burning with a blue flame destitute of light and affording an intense heat. Carbon, the basis of the illuminating gases, burns slowly, requiring the intense heat of the Hydrogen to perfect its combustion. The customary use of Coal Gas, under the pressure required to effect its delivery from the works to the consumer, is a positive indication of wastefulness, when it can be practically shown that under the most careful regulation at the faucets or at the meter, with the ordinary gas burner now in use, not less than fifty per cent. of the carbon escapes to the atmosphere unconsumed, its rapid passage not allowing tme to perfect combustion.—Therefore, to obtain a given amount of light, we are passing off nearly double the amounts of gas required if there was no waste. An escape of sulphuretted hydrogen to the same extent, or in any proportion, from its disagreeable odor would be unendurable; carbon being a colorless, inodorous, and almost tasteless gas, we are at a loss to discover its presence in an atmosphere so charged as to be pernicious to health. It is chiefly to the waste of carbon, and not to the false registry of gas meters, that we are taxed with exorbitant gas bills.

The Johnson Patent Gas Regulator & Burner combined, is so constructed as to regulate the pressure, creating a reaction of the current, and will admit only of the passage and consumption of a given amount of gas hourly, and can be regulated to pass say from one to four feet per hour, as the locality may demand, perfect combustion being effected by the slow passage of the gas through the burner, thus, the carbon being entirely consumed, a more powerful, efficient and steady light is obtained with the greatest possible economy.

We have also an improved attachment, designed more especially for use in banks, offices, libraries, sewing rooms, &c. The steadiness of the flame produced by this beautiful and ingenious device is without parallel! The Johnson Gas Burner and Regulator is substantial and ornamental; they are made entirely of incorrodable metal; the consumption of gas is not increased, and their practicable effects are unalterable from continued use.

READ THE FOLLOWING RELIABLE TESTIMONIAL.

(One of the 500 contained in our Pamphlets)

After thorough practical tests we are favored with the following statement from John Mowten, Esq., who has been for a number of years Superintendent of the New York Gas Works:

NEW YORK GAS WORKS, 15 November, 1859.

This is to certify that I have fully tested the "Johnson Patent Gas Regulator and Burner," and find it deserving of my unqualified approval, and do confidently recommend their general adoption by gas consumers, they require no regulation or attention on the part of the consumer to prevent waste from pressure, provided they are regulated to suit the pressure of the locality where they are to be used. JOHN MOWTON, MANAGER.

Send for Circular containing Certificates.

☞ The Johnson Patent Gas-Regulator and Burner Combined, are manufactured and sold by the Metropolitan Gas-Meter and Burner Manufacturing Company. Office, 592 Broadway, New-York.

SEYTON & WAINWRIGHT, 37 William street, New York city, Sotck and Exchange Brokers, General Railroad and European Agents. Stocks and Bonds bought and sold at the Board of Brokers, and at private sale. Railroad and other loans negotiated, and collections made for home or European account. *Exchange on London.*

C. S. SEYTON, J. H. WAINWRIGHT.

REFERENCES:

Duncan Sherman & Co., Richard Irvin & Co., John B. Murray, and Union Bank, New York; Webster Bank and Peter Wainwright, Esq., Boston; E. F. Satterthwaite, London; Alfred F. James, Galveston, Tex.; Ogden, Fleetwood & Co., Chicago; Erastus Corning, Esq., Albany; W. Fisher & Son, Baltimore; J. P. Kilbreth, Cincinnati; G. Parish Ogden, Troy.

BENJAMIN PIKE & SONS, Opticians. Importers and Manufacturers of Mathematical and Philosophical Instruments, No. 518 Broadway, (opposite St. Nicholas Hotel), New York.

Gold, Silver and Steel Spectacles; Barometers, Thermometers, Surveying Compasses, Theodolites, Levelling Instruments, Opera Glasses, Telescopes and Microscopes; Air Pumps and Electrical Machines. Instruments and Spectacles repaired. Periscopic Glasses and Pebbles.

DANIEL PIKE, GARDINER PIKE.

JOHN COOK & CO., MANUFACTURERS of the best Black Ink.

It will not corrode the pen nor mould in the Inkstand. A general assortment of Stationery always on hand. No. 42 Cedar street, New York.

OFFICIAL.

CROTON AQUEDUCT DEPARTMENT.—To Iron Founders:—Sealed proposals, indorsed, "Proposals for Cast Iron Water Pipes," will be received at this office, until 12 o'clock M., on Tuesday, the 20th day of March, 1860, for furnishing—

3,395 Tons of 4 feet Pipes, 12 feet 4 inches long.
35 Tons of Special Castings, for 4 feet pipe.
6,167 feet of 12 inches pipe, 12 feet 4 in. long.
3,700 feet of 6 inches pipe, 12 feet 4 in. long.
10,800 feet of 6 inches pipe, 9 feet long.

The Pipe to be coated with coal-tar varnish.

Specifications, form of contract, and blank form of proposals, and information in relation to the contract, can be had on application at the Engineer's Office of the Croton Aqueduct Department.

THOS. B TAPPEN, } Croton Aq'duct
A. W. CRAVEN, } Board.

OFFICE OF THE CROTON AQUEDUCT BOARD,
New York, March 1st, 1860.

PROPOSALS FOR BUILDING the Works of the CITIZENS' GAS-LIGHT COMPANY, of Brooklyn, N. Y.

The Plans and Specifications of the Works of the Citizens' Gas-Light Co., of Brooklyn, are now completed. Proposals for building the same will be received until the 10th of March. The Plans are ready for inspection at the Company's Office, No. 1 Post-Office Building, Montague street, Brooklyn, N. Y.

Proposals must be in writing, and addressed, under seal, to TYLER SABBATON, Engineer, at the Office of the Company, and endorsed "Proposal for Building Works."

J. S. LIBBY,
JOHN BLOODGOOD,
22 William-st., N. Y.

Office of the Citizens' Gas-Light Co. }
Brooklyn, N. Y., Feb. 24, 1860. }

H. R. WORTHINGTON'S PATENT Water-Meter.—This Meter combines accuracy, simplicity, and remarkable durability, with such ease and certainty of motion, as to offer no appreciable obstructions to the flow of water in the pipes to which it is connected, as it runs and registers upon three inches head, or when delivering the smallest stream. These qualities with its low cost, have caused its extensive adoption by corporations and individuals in many of our largest cities. Particular information can be given at the office of the undersigned, where a Meter can be seen in operation.

For sale, at greatly reduced prices, WORTHINGTON'S STEAM PUMPS, extensively used by Gas-Light Companies. Also, a new and highly successful PUMP, driven by water-pressure, requiring no attention or repairs, and the most economical water-meter yet constructed.

Patent GATES, for Water and Steam stops
HENRY WORTHINGTON,
28 Broadway, N. Y.

One of these Water-Meters can be seen in operation at the Rooms of the AMERICAN GAS LIGHT JOURNAL.

SITUATION WANTED. The undersigned, having had a number of years' experience in Building and Managing Gas Works, desires a situation as Engineer or Superintendent. The very best of references given. Address, "ENQUIRER," at rooms of the AMERICAN GAS-LIGHT JOURNAL, New York.

S. V. MERRICK, J. VAUGHAN MERRICK,
W. H. MERRICK.

SOUTHWARK FOUNDRY, Philadelphia.

MERRICK & SONS, Engineers, manufacturers of every description of Gas Machinery.

Retorts, Bench Castings, Condensers, Washers, Scrubbers, Wet or Dry Lime Purifiers, Coke Wagons, Fire Tools, Wrought Iron Grate Bars, Gasholders, either TELESCOPIC OR SINGLE, WITH SUSPENSION FRAMES COMPLETE; Wrought Iron Roof Frames, for Iron or Slate; Stop Cocks, Exhausters, Steam Pumps, Boilers and Tanks, Steam or Hand Air Pumps for proving Street Mains, Centre Seals, Governors, Wrought or Cast-Iron Lime Sieves for Purifiers, Purifier Hoisting Machines, &c., &c.

Address— MERRICK & SONS,
5th and Washington Streets, Philadelphia.

OREGON FOUNDRY, Nos. 740, 742, 744 Greenwich street, New York.

HERRING & FLOYD, proprietors, manufacture Gas Compensators of all sizes, Self-Acting Valves, Exhausters upon an improved plan, costing less than half those of English manufacture, also castings of every description for Gas and Water Works.

Herring & Floyd offer for sale Sabbaton's Patent Screening Shovels for coke and coals, made of malleable iron, of all sizes; Sabbaton's Patent Improved Cast Iron Furnace Frame and Door, arranged to protect the iron work of the door and frame from direct contact with the fire; also Floyd's Patent Malleable Iron Retort Covers, only quarter of an inch thick, but of convex form, and of great strength, as is attested by certificates from several of the leading Gas-works in America. For engravings of all the above patents see AMERICAN GAS LIGHT JOURNAL for October, 1859, pages 65 and 71.

Samples of the above castings can be seen at the Rooms of the AMERICAN GAS-LIGHT JOURNAL, No. 254 Canal street, East, near Broadway, New York.

OFFICE of THE METROPOLITAN Gas-light Company, No. 402 Fourth Avenue, New York, Jan. 20, 1860.

The following named gentlemen have been elected directors of this company for the ensuing year:

Christian H. Sand,	Edward Schell,
C. Godfrey Gunther,	Joseph Noble,
Eugene S Ballin,	Washington S. Whitney,
Edward Haight,	John D. Scott,
Hermann Marcuse,	James Hoy,
Thomas Achelis,	Robert H. Arkenburgh.

At a meeting of the Board of Directors held this day, CHRISTIAN H. SAND was unanimously elected President. W. TITUS, Secy.

BOSTON GAS-METER WORKS.—J. R. DARRACOT, Agent, No. 332 Washington-street, Boston.

Gas-Meters, of all descriptions,

and most approved construction, constantly on hand. Proof Meters and Station Meters, of superior workmanship, made to order.

FREEZING OF GAS-PIPES.—Walton's Patent Anti-Freezing Apparatus illustrated by engravings, in the AMERICAN GAS-LIGHT JOURNAL, of January, 1860, page 141, is the most simple, durable and efficient of any known process.

According to Professor Faraday, the watery vapor contained in illuminating gas amounts to 0·0093 parts where the gas is at a temperature of 40°, or in other words, that there are 1, 7-10 *gills water in every* 1,000 *cubic feet of gas* at that temperature. It is the deposit of this water in the form of frost that closes the exposed pipes.

Walton's plan is, in a few words, to supply this water with a sufficient quantity of alcohol (98–100ths), the vapor of which will enable it to pass through the most exposed pipes, unaffected by frost. Experiments of three years prove that one gill of such alcohol will protect 1,000 feet of gas at any temperature. Private houses, Hotels and Gas-works, can be thus guarantied from frost by the use of Walton's Anti-Freezer, which consists of but two or three small castings, at the most trifling cost. It can be applied at Gas-works without altering any of the pipes; and the expense of labor and the alcohol will not exceed two cents per 1,000 feet of gas.

It can be seen in operation at the rooms of the AMERICAN GAS-LIGHT JOURNAL, Iron Buildings, No. 254 Canal street East, near Broadway, New York city, where orders will be executed at once.

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[ADVERTISEMENT.]

SANDERS' WATER-GAS.

The improvement in the manufacture of illuminating gas, invented and patented by Prof. J Milton Sanders, and known generally as "Sanders' Water-Gas," consists in the passing of water, in the form of vapor, and any hydro-carbon, such as rosin, coal-oil, &c. into a retort of any form, at a red heat, containing charcoal or other carbonaceous material.

The mixed water-vapor and hydro-carbon are decomposed in association with each other and in the presence of the red-hot carbon, and new combinations of a gaseous nature ensue, which are supplied through the usual mains and pipes, and are found, when burned, to possess great luminosity and permanence.

The light derived from gas thus produced, exceeds in strength the light of standard coal-gas. It is of equal or greater stability. It is much purer, being free from all sulphurous or nitrous admixture, and emits an odor pleasant, rather than otherwise. The cost of its manufacture is not more than fifty cents per thousand cubic feet. It can be, has been, and will be, made at a cost still more reduced, according to locality, quantity demanded, and cost of material used.

In addition to its economy and excellence as an illuminating agent, the facility of its manufacture commends it peculiarly to the consideration of all parties interested in gas companies or gas works. To maintain a bench of water-gas retorts at a generating heat, for any given time, consumes no more coke or coal than to maintain at the same heat a bench of coal-gas retorts for the same period. But the yield per bench of the former will exceed the working ability of the latter, from three to five hundred per cent. This remarkable result is a demonstated fact, involving such a great saving of capital invested in land and machinery, as to be, of itself, worthy of special regard.

For two years past, Prof. Sanders' process has been continuously subjected to a series of experimental and practical tests, and to the adverse criticisms of those engaged in the usual modes of gas making.

About sixteen months ago, by the request of parties resident in the city of Philadelphia, who contemplated the purchase (since consummated,) of the Patent Right for the State of Pennsylvania, Sanders' process was introduced for purposes of examination at the City Gas Works, Market street, under the superintendence of Prof. J. C. Cresson, Chief Engineer. The report expected from that source, of the commercial value of Sanders' method, has not yet been communicated to the gentlemen under whose auspices Sanders' Water Gas was thus brought into public notice. But by the courtesy of Prof. Cresson and his accomplished assistants, very many gentlemen of intelligence, capital, and influential repute in this and neighboring cities, have been permitted to view the practical operation of Sanders' process; the nightly work of the whole establishment being now and having been for several months past carried on by the light of the water-gas. Uniform and even enthusiastic testimony to the purity, brilliancy, and economy of Sanders' process, is rendered by all who have thus been favored with the opportunity to inspect its action on a large scale, and is readily accessible by any person interested in the subject. And who has not a great interest in the progressive development of such an important accessory of health and civilization?

It has been urged against the claims of this invention, that it is an old and exploded plan; certain unsuccessful attempts in France, Belgium, England, and this country, recorded in text books and scientific journals, by which a mixture of gas produced by the decomposition of water, with other gaseous products, was essayed, being cited against this method.

Apart from the *prima facie* evidence of novelty, implied in the possession of Letters Patent from the United States—(granted after an examination unusually protracted and severe, wherein all these alleged prior discoveries and inventions were closely examined, and not until a successful practical demonstration had been made at Washington, before a Board of Examiners specially directed by the Commissioner of Patents, to witness the feasibility of the right sought to be protected by patent) —the difference between Sanders' Improvement and precedent failures can be easily shown.

Success, attained in a direction in which others have confessedly failed would indicate some new conditions and qualities; and, confirmatively, it will be found, that in none of the processes quoted as embracing the principles of Sanders' Patent, is there a mixture of water-vapor and hydro-carbon, previous to and simultaneous with their decomposition by and in presence of red-hot charcoal.

In the recorded methods of Ibbotson, of the White or Manchester Patent, of Gilbert Sanders, and of the numerous others who have labored in this department of scientific effort, it will be seen that a mechanical mingling of gases, generated in separate chambers, or at successive stages of the process, is either the avowed object or the actual effect. Such mingling of such gases did not, and necessarily could not, operate efficiently. It could not endure condensation by cold or time, or the travel through extended mains; and though plentiful and cheap, it could not be depended on for power of illumination or permanence. Water-gas made under Sanders' patent, has been preserved in a gas-holder for an entire year, and no diminution of quantity, or deterioration of quality of the gas was sensible.

Upon the famous "Manchester," or "White's Patent Hydro-Carbon" process, described in Clegg's work on Coal-Gas, and tried in England some years ago, particular stress has been laid, by some who fancy their interests threatened by Sanders's improvement, as destroying Sanders's claim for an original invention. But it will be seen by any one who will search, that the White Patent required the manufacture of coal gas in one class of retorts, the coal gas being afterwards conveyed to another retort, and therein mingled with the products of the decomposition of water.

Such is not Sanders' process. He insists upon the necessity of the mingling of water vapor and a hydro-carbon, either at the place of vaporization or in the retort, or on the way thither, before (even if but by an inappreciable division of time) the decomposition of either element, in one and the same retort, so that at the instant of generation, under the influence of heat, such new affinities and combinations may be operative as shall produce the gas required.

The very author quoted, (Clegg,) not only states the result of White's Hydro-Carbon Patent as "mechanical," but prefaces his description of the process by remarking that the apparatus is defective, but that "there can be little doubt that ultimately such modifications will be introduced as will render the manufacture as certain as that of ordinary gas-making." These essential modifications, being novel and original conditions, Sanders has accomplished. Within the enclosure of the Market Street Works, at a late date, could be seen the relics of the machinery erected there some years ago to try the "White" process, and abandoned as a failure. But Sanders's process is a living fact. It is producing daily its thousands of feet of the best illuminating gas, after a probation of more than a year.

It has also been asserted, in view of the fact that melted rosin has been the carbonizing element chiefly used in the experimental trials of this process heretofore, that the increase of the market price of that article, arising from the great demand that would be consequent upon a general adoption of Sanders' invention, would destroy all the contemplated economy of the improvement. To which it may be replied, that Sanders's process is by no means confined to the use of rosin. His patent covers any hydro-carbon—a class of substances varied and exhaustless. Already it is ascertained that, by his method, asphaltum from Cuba, of which millions of tons may be delivered here at the present prices of rosin, can be worked to better advantage than rosin, while the advances made in coal oil manufacture, daily cheapening the cost of that valuable adjunct, and the opening of new sources of hydro-carbon in many other quarters forbid any such apprehensions.

It has also been suggested that the expense of altering existing works would be so great as to hinder a general acceptance of this invention.

Establishments now engaged in the manufacture of coal gas would need no other change than could be easily and cheaply made, whenever the period arrives to renew their present retorts. The term of existence of coal gas retorts is from six to nine months. As the productive capacity of retorts making Water Gas far exceeds that of retorts making Coal Gas, while the cost of the former is no more than that of the latter, it follows that fewer will be needed to supply the aggregate of present production. Manifestly, therefore, there is an absolute economy of expenditure in the adaptation of the new process.

And, moreover, there cannot be any unusual or costly destruction of apparatus by Sanders' process. A bench of Water-Gas retorts may consume more fuel per hour (*not* per thousand feet of gas produced,) than a bench of Coal-Gas retorts, but both sorts are exposed to the fire in the same mode of setting, and the degree of heat to be maintained in the manufacture of Water Gas is that which is best adapted to the production of Coal Gas. There is, therefore, no external cause of speedy destruction, while within the retort there is no greater pressure, and there are in it fewer gases injurious to iron than in retorts yielding Coal-Gas.

The unreasoning and selfish dread of innovation, characterizing all vast vested interests, will naturally seek expression in disparaging statements concerning such a revolutionary invention as Prof. Sanders's process; but, believing that Nature will vindicate her own facts and functions, and that the demand of the people for cheaper and better light will be supplied, this explanation of a powerful element in the amelioration of our domestic and social state is respectfully submitted.

Philadelphia, Jan. 13th, 1860.

REPORT

MADE BY PROFESSOR J. J. MAPES, TO THE NEW-YORK WATER-GAS COMPANY.

I have visited Philadelphia, and have examined the practical operation of Sanders' method of making Water-Gas, as pursued in a portion of the works of the Philadelphia Gas Company. The engineer, Prof. Cressen, the assistant-engineer, Dr. Cressen, and his associate, Mr. Gay, gave me every facility for a thorough and careful examination.

They have been manufacturing gas on this plan for some months, and on my arrival I found one or more of their gas-holders filled with the Water-Gas, and thus had an opportunity of accurately testing its average quality, compared with the average quality of the Coal-Gas manufactured by the company. This was done in my presence by Mr. Gay, and repeated by myself, twice. The instrument used was the photometer belonging to the company, and which correctly shows the difference in quantity of light produced from a standard candle, consuming one hundred and thirty grains per hour, and the gas to be tested. This proved the Water-Gas to be worth 53, as compared with the company's gas at 47. The minutiæ of this calculation is with me, and open to inspection.

I spent Monday at the gas house, noticing the manufacture of gas, and rendering myself familiar with the operation, machinery, etc. On Tuesday morning, the 22d inst., the President placed the retort and appurtenances, with the necessary number of hands, at my disposal. The retort was heated red hot, and was charged with 83 lbs. of oak charcoal; the rosin hopper with 60 lbs. of rosin, and the retort was closed at 11 o'clock, the charcoal at that time being under full ignition. The steam was turned on without the rosin, and this furnished gas at the rate of 328 feet per hour, and of a peculiar quality. Its lighting properties were quite low, but the amount of heat evolved from this flame was evidently so much greater than that given off by the burning of the illuminating gas as to render it worthy of special consideration, when its extremely low cost is taken into account. As soon as the rosin became melted, it was suffered to pass slowly into the steam tube, and thus with it to find its way into the retort. The gas immediately assumed a superior degree of brightness, quite exceeding that of a coal gas burner alongside, and fully equal in quality, if not superior, to that tested on Monday by the photometer. The steam used was at a pressure of 25 lbs. to the inch. The fuel used was coke; and the workmen, who are very intelligent and accustomed to running these retorts, both with water and coal gas, informed me that the charge then in the retorts would continue to give gas at the same rate, and of the same quality, for 48 hours, at the end of which time half the charcoal would be consumed; that the quantity of coke to run this retort for 48 hours would be from 14 to 16 bushels, and for running the same retort, in the making of Coal-Gas, the quantity required would be 24 to 26 bushels. The information received from these workmen was corroborated the next day by the engineer and Dr. Cresson, as agreeing with their former experiments, except so far as relates to the quantity of coke consumed, which they supposed would be about the same, whether Coal or Water-Gas was made.

The same quantity of coke, however, would run three or more retorts, when properly set in the same bench, instead of one retort, as used in the above experiment. The inventor claims as the rationale for the production of gas, under his plans, that the steam is decomposed by the incandescent carbon, the hydrogen becoming carburetted-hydrogen by combining with portions of the carbon; while the oxygen takes up carbon, becoming carbonic-oxyde.

This is evidently true in degree, as shown in my experiments, with the steam and charcoal alone, before the introduction of the rosin. After the introduction of rosin, its decomposition and combination with the constituents of the steam change the light carburetted-hydrogen into heavy or illuminating carburetted-hydrogen; all of which is a fair hypothesis as to what may go on in the retort. At any rate, whatever may be the modus of the operation or combination within the retort, the practical result is the production of an illuminating gas of a superior quality to that usually made from coal, and at a cost very far below that of coal, oil, or other gas.

On Wednesday, when at the office of the company, the chief and assistant engineers answered the series of questions which I propounded to them. Among the facts arrived at were the following:

Selling price of charcoal at the works, eight cents per bushel.

That two or four retorts might be set in the same bench, and worked by the one fire.

That one man could attend to ten retorts, supplied with two streams of rosin each.

In making of Coal-Gas the quantity of coal used in such a retort as that used by me in making the Water-Gas, would be, per day, 2,200 lbs., and in their usual Coal-Gas retorts of double the size, 4,600 lbs.

That in making Coal-Gas, four men would be required per 24 hours to attend nine retorts, worked by three fires.

That the price of coke might be fairly estimated at five cents per bushel.

Prof. Cresson stated that these estimates were entirely dependable, so far as related to Water-Gas, as he had left a fair margin for safety, to prevent an under estimate as to its cost.

ESTIMATE OF A BENCH OF THREE RETORTS FOR WATER-GAS.

249 lbs. of charcoal, 15 bushels, 8 cts., - -	$1 20
2,350 lbs. of rosin, 50 lbs. per M feet of gas, ½ c.,	11 75
Labor, at the rate of 1 man at $3, to ten retorts,	1 80
Expense of steam, - - - - - - -	50
Cost of purification, not exceeding, - - - -	90
16 bushels of coke, 8 c., - - - - -	1 28
	$17 43

As the retort gave 328 feet of gas per hour, for 48 hours, the three retorts would give, in 48 hours, 47,232 feet, at a cost of $17 43, or less than 37 cents per M feet,

the cost of Coal-Gas made by the company being $1 20 per M feet, and the quality, as compared with the Water-Gas, only as 47 is to 53.

The retort used for Coal-Gas I consider quite inappropriate for the making of Water-Gas, notwithstanding the economical results shown above. One of the conditions called for is to pass the steam and the results of the destructive distillation of the rosin through incandescent carbon. This cannot be thoroughly done in a horizontal retort, because the Water-Gas being made partly at the expense of the incandescent carbon, it must leave an upper chamber, through which the steam and the results of rosin may pass above, and not through the incandescent carbon.

I would recommend a bench of vertical retorts, invented by S. Wetherell, of Bethlehem, Pa., by the use of which every particle of vapor must pass through incandescent coal, even until the last pound in the whole bench of retorts is consumed.

Yours, respectfully,

JAS. J. MAPES.

New York, February, 1859.

PURIFICATION OF GAS BY OXIDES OF IRON.

The recent discovery that the purification of gas by metallic oxides—by oxides of iron in particular, the disputed invention of which process has given rise to such prolonged and costly litigation—was *actually patented there upwards of half a century ago.* In the tenth volume of the second series of the "Repertory of Arts," at page 81, and in the 103d page of the seventh Roll's Chapel report, the invention is mentioned and described; and in the *London Gas-Light Journal* of July 10th, 1854, the invention appears second on the list of patents connected with the manufacture of gas, coming next after the celebrated patent of Mr. Winsor. Yet, strange to say, no one of the existing generation seems to have been aware of the objects of the invention, and the original specification might have mouldered unknown in the vaults of the Roll's Chapel, had it not been brought to light by fortuitous circumstances.

A workman named Francis Heard, employed in a pianoforte manufactory, having fallen into ill-health and poverty, his shopmates set on foot a subscription for his relief, and on making application to the officials of a gas-company in the neighborhood, it was represented that the father of Heard was one of the pioneers of gas-lighting, and had made several improvements in its manufacture. This statement induced further inquiry, when documents and papers were produced to establish his father's claim to that distinction. One of these was a patent granted to Edward Heard on the 12th of June, 1806, for "obtaining inflammable gas from pit coals, to burn without producing offensive smell." The specification of the invention describes a method of purifying gas by dry lime; and it also indicates in clear, precise and unmistakeat le terms, the purification of gas by such metallic oxides as will absorb sulphuretted hydrogen; and amongst them are distinctly specified oxides of iron. Thus Messrs. Croll, Laming, Hills, and the long array of subsequent patentees, seem to have been forestalled by an inventor whose very name had been forgotten.

At the time when Heard's patent was granted, Messrs. Boulton and Watt's factory at Birmingham, Phillips and and Lee's cotton mills at Manchester, and Mr. Lodge's mill at Sowerby Bridge in Lancashire were the only establishments lighted with gas, which was then supplied to the burners without being purified. Mr. Clegg was supposed to have been the first who attempted to apply lime to absorb the sulphuretted hydrogen from impure gas, and his purifying process by wet lime was introduced successfully in lighting Stonyhurst College in 1807; but it now appears that Mr. Edward Heard was the first person who thought of app ying lime for that purpose, though the mode of application was different. His process was essentially for the purification of gas by dry lime, which he secured by his patent in 1806; but the use of dry lime was again patented in 1817 by Reuben Phillips.

Heard seems to have been a man of great ingenuity, for, in addition to his patent of 1806, he took out one in 1819 for a portable gas lamp; another in 1829 for producing artificial light; and he also obtained four other patents for different objects. This was at a period, it must be borne in mind, when an English patent could not be completed for less than $600, and poor Heard suffered the fate of most other inventors who venture among the quicksands of patent monopolies. Having exhausted his credit, and squandered his possessions, in endeavoring to secure his inventions and bring them to perfection, he died in great poverty, without deriving advantage from any one of his numerous patents.

His specification is lucid and precise, and is expressed as follows:

"I stratify lime with the coals in the retort, stove, or other close vessel in which they are placed for operation, or suffer the gas, when produced, to pass over lime previously laid in an iron or other tube, or any other shaped vessel adapted for the purpose, and expose it to the heat. After the gas has been conducted into a refrigeratory, and all condensible matter is deposited, it is then suffered to enter the conveying tubes, and burned in the usual manner. My reason for employing lime for this purpose is, that from a series of analytical experiments I have detected the presence of sulphur in a great variety of the coals which are consumed in this country; and as I consider the suffocating offensive smell, so perceptible during the combustion of the gas obtained in the ordinary way, to arise from the products of that combustion, principally the sulphureous acid gas which is then generated. I present lime in substance to the sulphur as it is disengaged by heat from the coals, and through their mutual affinity arrest it in its progress, and form a sulphuret of lime or hydrosulphuret, depending on the circumstances of the operation. I have reason to conclude that any of the fixed alkalies or alkaline earths, such as barytes, strontian, and other similar earths, or carbonate of lime, when exposed to a degree of temperature sufficient to drive off the carbonic acid gas, might be substituted for lime, but from economical motives, as well as constant success, I prefer the agency of lime. It must, therefore, be clearly understood that lime in substance or a dry state, the fixed alkalies or earths possessing alkaline properties, or such metals, or their oxides, as possess a sufficiently strong affinity with sulphur and sulphurated hydrogen as to answer the end desired, such as iron, manganese, zinc, copper, lead, &c., when mixed with the coals laid on their surface, or put into separate vessels, through which the gas is made to pass, are calculated, in a greater or less degree, to divest the gas of the cause of the offensive smell; but I distinctly state that I have always found lime (if caustic the better) stratified with coals and exposed to heat, the most economical and successful process."

It will be seen that, though the patentee contemplated mixing the purifying materials with the coal in the retorts, yet he provided for their being used in separate vessels, through which the gas might be conducted.

EVANS' IMPROVED PHOTOMETER.

Mr. T. J. EVANS, Engineer of the Chartered Gas-light Company, London, has suggested* an improvement in the Photometer, by which it may be used in any ordinary room by day-light, or in the open air. It is said that the results obtained by it are much more accurate than by any other photometer at present in use, while the manipulation is said to be so easy and pleasant, that an experimenter may operate for hours together without fatigue to the eyes. We have written for one of these improved photometers, and meantime annex a description of it from an English publication:

"Next to the means of determining the accuracy of gas-meters, the means of ascertaining with precision the illuminating power of gas occupies for the moment a considerable share of public attention. All the gas acts passed within the last few years have contained clauses fixing the minimum illuminating power of the gas to be supplied; but, as our readers are aware, considerable latitude has been allowed to the mode in which that illuminating power has been ascertained. Rooms with dead black surfaces, and others covered with neutral-tinted paper, have served as photometrical laboratories, in which reflected and diffused light have been more or less completely cut off; but Mr, F. J. Evans is, we believe, the first person who has suggested the complete enclosing of the Bunsen photometer in a box, in such a form that it can be used not only in the laboratory, but for testing the illuminating power of public lamps *in situ*. For the former purpose he constructs a rectangular wooden box, about 14 or 15 inches square, and about 6 feet long, in which the greased screen is fixed at the distance of 50 inches from the gas-burner. This box has a ventilator at each end protected by hoods from the action of downward currents of air, and is blackened inside. The side towards the observer is formed of three hinged doors, the centre one containing a glazed aperture through which the screen may be observed. The candle moves backwards and forwards in a slot in the bottom of the box, and an external pointer indicates upon the scale its precise situation. Neither the gas-light nor the candle are seen by the obseryer, whose eye is therefore undisturbed by their rays in placing the candle at the exact point where the rays balance those emitted by the gas. For street purposes Mr. Evans uses a box of which the frame is of light wood filled up with black cloth, for the sake of rendering it portable. This, with a pair of tressels to carry one end of the photometer, is all that is required, as the other end rests upon the lamp-post from which the lamp is temporarily removed during the experiment."

CHLORINE AND BROMINE TESTS FOR GAS.

Among the methods for testing the relative richness and illuminating power of different varieties of gas, chlorine and bromine are used, and it may interest our readers if we give a brief account of each of these substances, and append a sketch of the method of practically applying them for testing gas.

CHLORINE.

The most valuable property of chlorine is its power of discharging vegetable colors, on which is founded its application in the arts of bleaching and calico printing. This property may be illustrated in many ways. By pouring a solution of litmus or indigo through a funnel, into a flask, containing chlorine gas, the decoloration takes place instantly, or, if the color is not completely discharged, it will be found, in a short time, to disappear. The same takes place when a solution of chlorine in water is used.

The peculiarities of chlorine in supporting combustion are remarkable, when compared with those of oxygen gas. A piece of paper, dipped in oil of turpentine, takes fire in a moment at common temperatures when placed in a jar of chlorine, and, as we have seen, phosphorus and several of the metals undergo spontaneous ignition in the same manner. These phenomena depend on the intense affinity which chlorine has for electro-positive bodies, but it is very remarkable that it seems to have little disposition to unite with carbon. As in the burning of a taper, so in this experiment with turpentine, it is the hydrogen which burns, and the carbon is evolved in clouds of smoke.

Chlorine is also used by physicians for the purpose of destroying miasma, and the effluvia of sick rooms or other places. It is necessary, from its irrespirable qualities, to disengage it slowly and with caution where patients are present. The chlorides of soda and lime are commonly used.

Free chlorine may be detected by its smell, its bleaching action on indigo solution, and giving a white, curdy precipitate with the nitrate of silver. Its solution in water is readily made by introducing a small quantity of water into a bottle full of chlorine, agitating it, and opening the mouth of the bottle from time to time under water; the gas being gradually absorbed, the bottle becomes full of water, which, of course, contains its own volume of chlorine. This solution decomposes in the sunshine, evolving oxygen gas, the water being decomposed.

In operating with chlorine one measure of chlorine-gas is introduced into a jar inverted over water, containing two measures of coal-gas. A diminution of the volume of the gas will quickly ensue, and an oily liquid will be found by the carbon vapors uniting with the chlorine. Any excess of the latter must then be removed, by the introduction of a few drops of solution of potash. The diminution of volume which the remaining gas has undergone indicates the illuminating power, by throwing the amount of carbon vapor that has been absorbed. The objection to the chlorine process is the difficulty of manipulation, which is considerable, and, excepting in well experienced hands, its indications often prove fallacious. The experiments require to be conducted in the dark, or at least by candle-light.

BROMINE.

Bromine occurs in sea water, and also, to a more considerable extent, in certain brine springs both in America and Europe. From these it may be obtained by evaporating the water until the salt solution is concentrated, and after the chloride of sodium has crystallized from the liquor, passing through it a current of chlorine gas, the solution turning yellow as the bromine is set free. It is next agitated with sulphuric ether, which carries to the surface all the bromine. This is then acted on by potash, which gives a mixture of bromate of potash and bromide of potassium. On ignition, oxygen is expelled, and the whole converted into the latter salt, from which the bromine may be distilled by the of aid peroxide of manganese and sulphuric acid.

It is a liquid of a deep blood-red appearance, solidifying at 40° F., and boiling at 113° F. Its specific gravity is 2.99. It exhales an orange vapor, and is commonly kept beneath the surface of water. Its smell is very disagreeable, a circumstance from which its name is derived. Like chlorine, it bleaches, and in all its relations possesses a general resemblance to that substance. A lighted taper burns for a short time in its vapor with a greenish flame. Phosphorus burns spontaneously in it.

The method of ascertaining the amount of condensation produced in coal gas by the addition of a single drop of bromine, is now preferred to the use of chlorine, which presented some difficulties in estimating the volumes to be mixed.

For the purpose of testing gas with bromine, a glass tube is used, about three feet long and half an inch diameter inside. The tube is closed at one end and bent at the other into a small semicircle, so that the straight part of the tube is about 33 inches long, the remaining 3 inches being occupied by the bend. The straight part of the tube is graduated into hundredths towards the closed end as far as 25 divisions, or one-fourth of the length; this graduation serving to show the diminution in the volume of the gas effected by the bromine.

The tube is to be filled with water and the curved or open end placed over an orifice from which the gas is allowed to flow. After passing up through the water the gas begins to displace the latter, and must be allowed to do so till the gas exactly fills the tube from the zero division or the beginning of the graduation to the top of the tube. The curved end of the tube remains filled with water, which acts as a seal and prevents the escape of gas. It is usual now to add a few drops of a solution of potash to remove any cabonic acid which may be in the gas. A portion of bromine, about the size of a small pea, is then dropped into the open end of the tube, and the thumb being placed firmly on this open end, the tube is to be inverted once or twice so as to bring the bromine into perfect contact with the gas. After two or three invertions of the tube the thumb may be withdrawn under water, and a few drops of a solution of potash added, in order to remove from the tube the vapor of bromine contained in it. To effect this removal the thumb is to be again pressed on the open end of the tube, and its contents again agitated by again inverting the tube once or twice. The open end of the tube is then to be placed in water, which will now rise considerably above zero, and after remaining at rest for some time, the height of the water may read off on the graduated part of the tube. The division so read off will of course represent the condensation of the gas in parts of 100.

Some of the inferior gases are not condensed by bromine to the extent of more than 4 or 5 per cent., while some of the rich and highly illuminating cannel coal gases are condensed as much as 12 and 14 per cent.

* "Suggested" is the term used by Mr. Evans; from this we infer that he is too public-spirited to patent it. Mr. King, of the Liverpool United Gas-works, has never patented any of his inventions, being principled against it.

PRACTICAL MANAGEMENT OF GAS WORKS.

In the series of articles of which the present is to serve as the salutatory, their author is well aware that the task which he is assuming is a very delicate one.

The opinions of engineers are various upon certain episodes in every-day practice, and, while to harmonize these diversities is scarcely the province of the essayist, he may, without any suspicion of egotism or assumption, so present them as to furnish food for the thinking mind.

And whether or not this record of hard solid facts of practical means to practical ends, be met with favor by its readers, it cannot but be conceded to be a properly directed attempt to strip the art of gas-making of the tinsel and mysticism of sublimed science—to give the engineer matter for habitual reference, and to afford a standard by which he may judge of his own results, whether they surpass or whether they fall below it. Clegg, Peckston, and Hughes, are, to be sure, volumes necessary to a gas-engineer's library, and highly useful in elucidating the more abstruse principles of matured excellence in his profession; but they take too much as granted, and ignore the *substructure* of facts and results which the gas-maker must build up for himself, as best he may, by a hard and sometimes a sad experience. What does the manager of a small gas-work care whether coal-tar contains "chlorodibromanaline" or not, so long as he gets 9500 feet from the ton of coal, and 4000 feet per diem per retort? What does it interest him to study the absorptio-metric miracles of the chemist, if the same time spent in his retort-house or in the streets, will improve his heats or diminish his leakage? This vacuum in gas literature has been long acknowledged, and if the present articles do not perfectly fill it, they will at least serve as a nucleus around which the suggestions and comments of American gas-makers will cluster themselves into a shapely and valuable mass. It cannot be supposed that the opinions to be advanced and the practical *minutiæ* to be detailed, will chime entirely with the experience of my brother engineers; but a confident appeal is made to their courtesy and forbearance to accept the spirit of diffidence in which I write, as some palliative of possible errors, whether those errors be negative or positive, of omission or of commission.

The first and most evident, as well as the most important considerations in gas management, are the characteristic features of the retort house.

This, in small works, where a single stack of benches is employed, should be 30 feet wide inside, and not less than 20 feet high to the wall plate, covered with a wrought iron truss roof, and slated. The trusses should be 5 feet or 5 feet 6 inches apart, with king posts of such length as to give the rafters a slope of 1 in 2, or say 7 feet 6 inches long for a building of 30 feet clear span. The architectural symmetry of a hipped roof has led to its extensive adoption, but this symmetry is its only recommendation; as in a building 100 by 30 feet, for instance, a hipped roof leaves but 70 feet of longitudinal ridge available for a ventilator, and, in consequence, holds the smoke from the benches at each end of the house, while an ordinary roof permits the ventilator to run the full length of the building. It may here be observed, that the most admirable specimen of a trussed roof and ventilators which the writer has ever seen on a retort house, occurs at the 18th street station of the Manhattan Gas Co., N.Y. city, comprising not only a large central or ridge ventilator, but also wing ventilators along the sides of the roof, at a distance of about two-fifths of the length of the rafters, from the main ridge. The question of ample ventilation has latterly acquired new importance from the disuse of cumbrous and expensive chimney-stalks, and the substitution in their place of a small double-flued chimney to each bench, rising only 3 or 4 feet above the top of the latter. In a line with the centre of each bench, a pair of substantial eye-bolts should be built, one in the back and one in the front wall of the retort house, and at a height of 12 or 14 feet above the floor, the specific purpose of these eye-bolts being to receive the guys of the shear-legs by which the retorts, are placed on, or removed from their beds. The very general use of fire-clay renders unnecessary any lengthy allusion to iron retorts, and in this and succeeding articles direct reference is had to the most advantageous treatment of clays.

We now come to the consideration of the benches. These should rest upon a solid foundation of concrete, 12 or 15 inches thick; the top of the ashpan being from 9 to 12 inches below the door sill, between which two levels the floor should run with a continuous slope. For the floor no material is equal to paving brick laid true in carefully rammed sand; stone flagging and iron soon wear smooth, and while the former cracks easily under the heavy charging barrows and cars, the latter becomes intolerably hot. Where "Threes" are used the ordinary clear width of arch is 6 feet 6 inches, with about equal height from the top of the ashpan to the crown of the arch. The intermediate piers (separating the benches) are 1½ brick, say 14 inches thick; and the end piers 2½ or 3 brick (23 to 27 ins.) The stack of benches was formerly tied together, both longitudinally and transversely, by round rods of 1¼ ins. diameter, which passed through and were secured to flauch-and-rib bench braces; but the transverse tie-rods and their braces are now displaced in new works by double courses of blocks (each 28 by 4½ by 5 ins.) laid longitudinally, so as to break-joint, in the centres of the intermediate and end piers of the stack. These double courses of blocks occur at vertical intervals of about 2 feet from center to center, and are found to be far more efficient to durable work than the alternative of iron rods, which are speedily rendered useless or destroyed by the high temperature which they experience.

The end braces should have a flanch 6 inches wide and 1 inch thick, and a rib of 1½ inches thick, and 8 inches depth, for Threes, being proportionately heavier for a stack of Fives; it may be asserted, however, that compound or trussed braces would more appropriately and perfectly sustain the enormous strain due to the expansion of the brick work in either case. The braces are firmly secured at bottom by anchor-rods, firmly imbedded in the concrete bench foundation, and joined in pairs at top by tie-rods which run the whole length of the stack, and should be at a hight of 9 ins. above it, so as to permit the circulation of a free current of air.

The expansion of iron retorts is so great as seriously to affect the arches in which they are set, and although the use of clay retorts almost entirely precludes this difficulty, it is of essential importance, in either case, that the range of benches be tied securely in the directions of both its length and depth.

It is an improvement to adopt a square reveal for the reception of the facing wall instead of the old form of a circular arc, turned with a radius 4½ inches greater than the interior face of the bench, and from the same center, as the square reveal does away with much of the cutting and shaping of brick, which was formerly necessary in carrying up the facing. The projection should be protected and supported by a bar of 4½ x 1 in. iron, of sufficent length to lap about 3 inches at each end on the piers.

Of the setting of a bench of retorts, it may be observed that there is no department of gas management which more nearly concerns the prosperity of a company. Be the material employed ever so rich, be the mains ever so tight, be the financial administration ever so prudent, the operation of these auxiliary *desiderata* may be completely paralyzed by low heats. Most gas-makers have, at one time or another in their career, been bestridden by this "old man of the sea," and can remember their buoyancy and relief when an improvement in their settings has brought their retorts to a bright cherry red, or it may be, to an incipient white. High, uniform and manageable heats must be secured, to which end my first advice to beginners in gas-making is: "Make no experiments." If any such are troubled with low heats, let them procure from some one of the larger companies the tracing of a reliable setting, and adhere rigidly to that path which a more matured experience has pronounced the correct one. In saying this, I may be accused of an attempt to trammel original talent; but talent, misdirected, or without the guidance of experience, is, not unfrequently, a very *ignis fatuus* to its possessor.

In bench-setting it is advisable to employ but one man, or set of men, and to teach them to work to plans accurately, carefully, and understandingly. They should not be permitted to assume the responsibility of any deviation from the working drawings before them, upon which drawings, by the way, should be distinctly specified, *in figures*, every dimension of every part of the setting.

Common brick may be used in putting in the filling, up to within one course of the bottom flues, excepting the front course and those around the ash-pit—these should be of fire brick. This filling should be 1 inch clear of the piers and back wall all around, and carried up in blocks of about 4 feet in plan, with similar interstices between them; all these interstices should communicate with each other, and with two small openings through the front wall (say 3 x 2½ ins.) one on each side of the bench and next the pier, and one course above the floor line. These connecting spaces not only allow room for the expansion of the filling, but also afford means of exit for the vaporized moisture. In fire work the closest and most uniform joints are necessary, but simply impossible if fire brick be laid without selection; as they come from the makers they are of varying thickness, because whatever the uniformity of the press, they are of different degrees of moisture, and subsequently exposed to different temperatures in the kiln. It has been suggested to plane or grind every brick down to a mathematically uniform thickness, and so secure close and perfect work. In theory this advice is admirable, but it is a refinement of practice only possible in the largest works, if at all, while its aim is sufficiently secured by providing the retort-setter with a couple of guages with which to sort the fire brick for the furnace, into three classes as to thickness, small, medium, and large, and instructing him to run each full course around the fire-bag, with bricks of a single class. In the remainder of the setting such nicety is not necessary as is demanded by the intense and searching heat of the furnace. The whole of the filling proper should be of common brick, laid in lime mortar, except the course which forms the bottom of the lower flues, which being directly exposed to the heat, should be of fire brick, laid in fire mortar. The whole of the facing wall and the first three courses next above the ash-pan, which support the grate bearers, are also laid in lime mortar, but must be of fire brick. The fire brick should be thoroughly wet before being laid, and in carrying up the furnace, each brick should be driven separately home with a mallet or similar suitable instrument until the thickness of the joint is next to nothing; they should be laid in mortar composed of three parts of fire clay, and one of ground fire brick, mixed very thin, and carefully run through a fine sieve after being mixed. It is a matter of debate whether pure clay is not preferable to any admixture of ground brick. The face of the bench may advantageously have a batter of three inches from the floor line to the bed of the bottom retorts, thus increasing the tendency of the furnace doors to close and remain closed. Specific reference will be had to the most advantageous construction of the furnace, in a succeeding number of the AMERICAN GAS-LIGHT JOURNAL.

The ordinary form of retort is the large D, 20 inches broad, 12 inches high, (both inside measurement) and from 7 feet 6 inches to 9 feet long. The Belgian clay Retorts, of Keller's make, are about 2½ inches thick, and a retort 8 feet 9 inches long, weighs 1180 lbs. In symmetry of appearance and beauty of color, they are unrivalled by any retorts which have as yet come into use in this country, although in these non-essential points, they are even surpassed by the fabrics of Gautier, of Jersey Cty, N. J. The admirable security with which Keller's Retorts are packed, renders it simply impossible for them to receive any injury *in transitu*, except as the result of the most culpable carelessness or the most willful mischief; they have been more generally introduced than any other retorts up to this time, and will last, with anything like fair treatment, a working average of 20 months.

The continental experience of the relative advantage of clay and of iron retorts, is briefly summed up in the following statistics, obtained through the courtesy of Messrs. Elliman Brothers, of N. Y. city. "In the year "1847, iron retorts were used, and produced on an aver- "age, 8,820 feet of gas per ton, and 3,146 feet per retort "in 24 hours. In the year 1848, half of the iron retorts "were replaced by clay retorts; the production was "9,072 feet per ton of coal, and 3,373 feet per retort in "24 hours. In the year 1849, all the iron retorts were "put aside, and the production got up to 9,240 feet per "ton, and 3,401 feet per retort in 24 hours. Since that "time the production has still been increased, princi- "pally the production per day, which reaches now 5,000 "feet per retort, this owing to the higher heat the "benches have been brought up to."

A number of English retorts, of the manufacture of Joseph Cliff, have also been imported for our gas companies. These retorts look solid and serviceable, have none of the seductive beauty of Keller's or Gautier's, and are much heavier than the former, one of Cliff's, 8 feet 5 inches long, weighing 1,480 lbs. They have not the *prestige* in this country which priority of importation and great absolute merit have secured for their continental rivals, but no retorts enjoy a higher rank with English engineers, and they will doubtless earn for themselves a similarly favorable verdict from those of America. And while on the subject of English clay retorts, it is interesting to quote the following from an address by the chairman of the City of London Gas Company to its shareholders, at their half-yearly meeting, Jan'y 19, 1859. Mr. Gray says: "I will only trouble you with one other "remark, and that is with respect to clay retorts, by the "use of which I think gas companies generally have de- "rived great advantage. For my honest belief is, that "if clay had not been introduced, and we had to use "iron, instead of being able to pay 5 per cent. dividend, "many of the companies would scarcely have been able "to keep their doors open at all. Iron retorts of the best "make will not continue to work well for a period ex- "ceeding ten months, and the expense of setting a bench "of iron retorts is very nearly as great as the cost of a "bench of clay. Just see the difference. *We have* 486 "*clay retorts in action*, 196 *of which were four years old* "*last November, without being replaced. Those taken out* "*last year to be re-set were over five years old, and had ac* "*tually worked nearly four years, and all were in the most* "*efficient state for generating gas.*"

The italicising is my own. Such a record as this certainly speaks well for the retorts of English makers, and for the high engineering skill applied to their setting and use.

Having thus alluded to the Belgian and English retorts, it should be remarked that with the acknowledgement of the superiority of fire clay over iron, as a material, and as its legitimate result, the manufacture of clay retorts in America has had birth and stimulus. In addition to Gautier—to whom reference has already been had—fire clay, or as in this instance they are barbarously called "pyro-clay" retorts are made by Thomas Hoadly, of Cleveland, Ohio.

Of the trio of American makers, however, Messrs. J. K. Brick & Co., of Brooklyn, N. Y., posseses the most secure fulcrum for their operations, in the enormous demand which exists for their fire goods of other descriptions. The retorts of Brick & Co. have a metallic ring when struck, but of higher tone than Cliff's or even Keller's; yet their grain is less firm, and they must be handled with care, being loose and granular in fracture. This feature is claimed to be a necessary accompaniment of great durability and strength *when heated;* and in the present state of our knowledge upon the subject, it would be presumptuous to say that some analogy may not exist in this respect to the retorts made from "coldshear," or "coldshorf" iron. These iron retorts, although exceedingly brittle and hard when cold, are found to experience a change when brought to a working heat, becoming tough, durable, and more refractory, and outlasting retorts made from the soft gray metal which is so much preferable for ordinary purposes. Mr. Brick has adopted a 'skeleton' setting of Fives at the Brooklyn Gas Works, in which these retorts are supported at the back and front only, and set without any protecting tile whatever. This severe test, it is stated, they have successfully borne, thus economizing labor and tile to the amount of $40 or $50 in each setting of Fives. The retorts of Messrs. Brick, 8 feet 7 inches long, weigh 1,150 lbs. each; in the style in which they are packed, they are inferior to Keller's. With this allusion to the retorts most generally known among American gas-makers, the remarks preliminary to their manipulation, come to a close.

Of making the mouth-piece joint, various modes are suggested, and in the use of Brick & Co's., Retort, the makers specifically recommend the following course. "After the Retorts are laid and walled in, then put on "the mouth-pieces with the mastic described below. Be "careful to have mastic enough prepared for only one "mouth-piece five minutes before you have use for it. "Prick the front of the retort with a sharp hammer; this "done, spread the mastic over the surface of the head of "the retort with the hands as rapidly as possible. I ave "no part uncovered. The mouth-piece may then be "placed on, and forced up to about ¼ inch joint by means "of an ordinary screw-jack, making the outer wall of the "retort-house a fulcrum for the lever or beam Make the "inside and outside joints smooth with a small trowel, "cover them with red lead, and the operation is com- "pleted. The bolts should be secured, and the bolt-holes "filled in with a mixture composed of one-third finely "pulverized clay, and two-thirds fine saw-dust. thoroughly "incorporated; this will prevent the cracking of the "retort by the expansion of the iron bolts.

In general, however, it will be found most advisable to set the retorts on end, mouth up, as in this way greater ease of access to the joint is obtained, as well as greater facility of securing the bolts in their slots. The weight of the mouth piece also acts to the uniform compression of the cement, and numerous minor advantages attend the plan. The retort b ing placed on end, the bolts should be entered in their slots and the mouthpiece lowered to its place. Having mixed enough Plaster of Paris, *very thin* to run a single slot. center the bolt to the corresponding hole in the mouthpiece flanch, through which hole pour the Plaster of Paris, by means of a funnel into the slot in the shoulder of the retort. After securing each bolt in this way (having previously given it a quarter turn so as to take hold), allow a few minutes for the gypsum to set. raise the mouth piece carefully clear of the retort and its bolts, and scrape off any excess of gypsum which may have adhered to the retort. Nothing now remains but to plaster over the retort-shoulder with the cement, lower the mouth-piece again to its place, put on and screw up the nuts, and point the joint inside and out with a small trowel. Before making the joints, it is well to dress the shoulder of the retort to a rough face by means of a pick and to moisten it thoroughly with water; it is necessary to set up the joint, after the retort is in its place in the bench.

The recipes for the cement to be used in making mouth-piece joints are various: it is not however in the power of the writer to state the absolute efficiency of any, and the general experience of engineers seems to be, that a certain amount of leakage at this joint is unavoidable during the first few weeks of charging, at the expiration of which period the tar and infiltrated carbon have usually made the joint perfectly sound.

The following mixtures come most highly recommended:—

"For jointing the mouth-pieces, take 20 lbs. of gypsum "(sulphate of lime), and make it into a pulp with water; "add to it 10 lbs of iron borings, saturated with a strong "solution of sal-ammoniac (muriate of ammonia). Mix "the whole well together till it is of a consistency fit for "use."—*Clegg on Coal Gas—3d Edition, p.* 134.

"A mixture of three-fourths fire-clay and one-fourth "iron borings."

JOS. A. SABBATON,
Eng'r. Manhattan Gas Light Co.

"Five parts of fire-clay; five parts borings; one part "salammoniac; three-quarter part Sulphur (powdered). "Mix them with Ammoniacal water, but not before you "are ready to connect the mouth-pieces to the retort."

J. K, BRICK,
Eng'r. Brooklyn Gas Light Co.

(To be continued.)

THE LOUISVILLE GAS-LIGHT COMPANY AND THE CITY COUNCIL.

One of those bold measures to deprive a corporation of its rights by an arbitrary act of legislation, has been lately attempted in the General Council of Louisville, Ky., by the passage of an Act intended to deprive the Gas-Light Company of that city of its charter and nearly half of its property; and but for the vigorous resistance of the company, it might have been carried to a successful issue in the General Assembly of the State. We feel quite safe in asserting that nine-tenths of the municipal legislation in this country, is based upon a greed for plunder, to be got at all hazards, and when obtained, appropriated to personal aggrandisement, as unblushingly as it was taken. This feature is noticeable in every city council in the Union, from New York upwards. But the Louisville Council have a man to deal with who will not stand much trifling. Mr. Robert G. Courtenay, the President of the Gas-Light Company, is a man of emphasis and nerve, and we guarantee that there will be no necessity for the "brakes" to prevent his backing down from any position which his sense of right and justice may have led him to assume.

The charter of the Gas Company will expire on the 31st January, 1869, and the Legislature have no right to interfere with it before that period. Under its protection private individuals were induced to invest their capital, and confer the blessing of good light upon the community. For many years they had but a small return, simply because the city had hampered the grant with conditions that prevented it, and at no time have the dividends been immoderate; indeed the average has not, we believe, exceeded seven per cent. But if they had been fifty per cent per annum, the Company's rights are invulnerable, and should be protected by it at any hazard, as there is no fear but they will be.

ANNUAL REPORT OF THE PHILADELPHIA GAS WORKS.

John C. Cresson, Esq., the Engineer of the Philadelphia Gas Works, favors us with his annual report, from which we are able to present but a synopsis.

The new works at Point Breeze, are rapidly approaching completion. They comprise

1. A Retort House, 250 feet long by 57 feet wide, and 57 feet high from the foundation.

[This building has been since partially destroyed by a tornado.—Ed.]

2. A Purifying House, 111 feet by 58.
3. A Boiler House, 46 1-2 feet by 25.
4. A range of work shops for the smiths, fitters and carpenters, 350 feet in length by 28 in width, all built of durable sandstone, and roofed with slate.
5. A Tar Cistern, 40 feet in diameter by 20 feet deep; a number of small cisterns, to serve as lime traps to remove this sedimentary deposit from the drain culverts.
6. A second hoisting tower at the wharf, working with hydraulic machinery.
7. Additional railway tracks, 2,300 feet in length, for the conveyance of heavy material about the premises.

The Manayunk and Kensington Gas Works have been purchased from those companies, under the ordinance of May 10th, 1858, "for the further extension of the Philadelphia Gas Works."

The amount of gas produced in 1859, is 562,110,000 cubic feet, being an increase of 82,000,000 cubic feet, over the last year, being by a curious coincidence about one million feet for each mile of pipe added in the same time.

The largest consumption in 24 hours, was 2,700,000 cubic feet, on the 24th December, 1859, on which day the quantity made reached an equal amount.

Coal carbonised in 1859	57,309 tons.
Lime used in purifying	112,909 bushs.
Wood consumed	671 cords.
Greatest number of retorts in use at any one time	468.
Largest daily average yield of each retort	7,715 cubic feet.
Largest quantity from each pound of coal from any full day's work	4·74 feet.
Meters and services set in 1859	4,510
Total meters now in use	36,311
Total services do do	36,426
Applications registered during the year	14,008
Total gas consumers on the books	37,589
Public lamps in use	4,962
Length of street mains laid in 1859	314,003 ft.
Total length of street mains	1,790,865 or 339 miles.

With such energy was this last department carried forward at the urgent demands of the citizens, that 45,000 feet of main pipe was laid in a single month.

CASH ACCOUNT. *Dr.*

Balance on hand Jan. 1, '59,	$84,043 48	
Receipts in '59 for gas, coke, tar, lime, main and service pipes, rents, &c.,	1,140,617 72	
For interest on loans &c.,	416,408 86	
		$1,641,070 06

Cr.

Payments in 1859 for construction and enlargement of works, extension of mains, service and main pipes, meters, coal and other materials, repairs &c,	$1,143,764 65	
Interest on loans, cost of new works, &c.,	363,950 84	
Balance on hand	133,354 57	
		$1,641,070 06

Mr. Cresson, in alluding to the various contrivances for securing the wet gas meter from the action of frost, says that alcohol while guarding it from freezing, is inconvenient because of its rapid evaporation, and in 1843 he had tried the solution of neutral chloride by introducing it into several hundred meters. It did not freeze at the lowest natural temperature, and the strong affinity of the salt for water prevented rapid evaporation, while its specific gravity being greater than that of water, gave full support to the valve-float and effectiveness to the hydraulic sealing. The results of the first year were entirely satisfactory, but at the end of the third year the metals of the meters showed such unmistakeable evidence of the destructive action of the solution as led to its abandonment. We believe this is Gengembre's fluid.

We have at these Rooms two vessels in which this fluid has been in connection with meter metal for four months. In the one without the gas, the metal is quite corroded. In the other in which gas is admitted, the metal is as bright as when new.

More recently he has tried another liquid with encouraging prospects of success. It is the inert substance obtained from fatty bodies, known as glycerine. It is capable of resisting our lowest natural temperature, maintains its fluid very pertinaciously and is considerably heavier than water. Should it manifest no injurious action on the meter metals, or other defects it will completely meet the wants of the instrument.

The Chief Engineer concludes with a well merited eulogium upon two of his subordinate officers upon whom has devolved the principal share of executive responsibility of the large amount of work performed. These are Mr. John A. Miskey, Superintendent of Distribution, and Dr. Chas. M. Cresson, the First Assistant Engineer.

CHARLOTTE, N. C.—This is one of Waterhouse & Bowes' works, which appear to be always successful. This firm has been always ready and always prompt to reply to our enquiries, and we have heard the best reports from others of their works. These are rosin works of small capital, having but $15,000 in use; are managed judiciously, and report that they pay ten per cent. semi-annually.

PRODUCTS OF THE DISTILLATION OF COAL.

Experiment has shown that the changes which occur when animal or vegetable matter is subjected to the action of heat, vary in proportion to the range of temperature. In circumstances where the material operated upon is in contact with a plentiful supply of heated air no, deprived of its free oxygen by any act of combustion the whole or much the greater part of the carbon will be burned off as carbonic acid; some carbon may remain behind mixed with the earthy matters of the organic substance forming the ashy coke. The hydrogen in the substance will escape as water at first, and if much be present, as carburetted hydrogen; and with the nitrogen (if the substance contain any) as ammonia, as a carbonate of ammonia. But when the exposure to heat is conducted in close vessels, as in distillation in retorts, another series of changes occurs; at the outset, when the heat is inconsiderable, aqueous vapor, organic acids, ammonia, and some combustible fluids, soluble in water, are given off. As the temperature augments, carbonic acid, carbonic oxide, water, and a number of oleaginous substances not soluble in water, are formed. When the temperature rises up to and exceeds a red heat, the products are in great part, or wholly gaseous.

Destructive distillation may be considered as combustion with a very limited supply of oxygen—merely so much as is contained in the substance itself. The results of the dry distillation of substances vary in so far as they contain or are deficient in nitrogen. Most of the products are common to both conditions, but where nitrogen is an element, there are many substances formed peculiar to it.

In the cases of organic substances not containing nitrogen, as wood, resin, oils and fats, &c., the chief products of distillation are—water, acetic acid, naptha, or wood spirit, volatile oil, tar, parafine, creosote, &c.

When the substances contain nitrogen or sulphur, as coal, &c., there are added to the foregoing—ammonia, aniline, leucol, picoline, lutidine, &c., cyanogen and sulpho-cyanogen compounds.

And in all cases, an ashy carbonaceous mass remains in the retort or still, known as *coke*. Such are the changes produced at a temperature below a red heat; at temperatures above this point, a series of gaseous products only are produced: and if there does not appear in the ordinary manufacture of gas a large amount of the above *volatile liquids*, it is because they are formed when the retort has from any cause been cooled down below a red heat, when they immediately appear, and are distilled over.

It is the temperature at which coal is carbonized in close vessels which determines the nature of the products—if it be high, gaseous fluids will be produced; if it be low, volatile vapors (liquids) alone will form. This is now so well known by manufacturers of gas, that the utmost care is exerted to keep the retorts at a cherry-red heat (1400° F.)

The results of dry distillations are always very complex; the number of products very great, and difficult of separation.

"The difficulty of tracing the decomposition of organic matters by heat arises from variations in the temperature, and the non-removal of substances already formed, which in turn are themselves decomposed, and the products of two decompositions become mingled together. Thus, under careful management, the distillation of acetic acid gives acetone and carbonic acid; malic acid gives water, malic acid, and carbonic acid; but if the temperatures change, another set of decompositions occur, a new set of products are formed, arising from the disruption of the atoms of the first; thus acetic acid gives marsh gas, and malic acid gives fumaric acid; hence, if substances be taken, through which, either from their mass or their non-conducting power, the heat cannot be uniformly diffused, a number of different reactions take place in different portions at the same time, according to their respective temperatures; the bodies generated in the interior are altered as they approach the surface, and hence a very high degree of complexity is given to the ultimate results."—(*Kane.*)

This is exactly the condition in which the distillation of coal is placed; a mineral having an indifferent conducting power, and in comparatively large masses, exposed to a high temperature, becomes unequally acted on, and frequently, while the interior of the mass is evolving vapors, which subsequently condense into oil, the exterior is giving off gaseous carburets of hydrogen; hence the necessity of having the coal broken into small fragments.

In the production of volatile oils from bituminous substances, the same attention to temperature must be shown; when a dull red heat (about 800°) is obtained, permanent gases begin to form in abundance; hence, on no account should such a temperature be allowed. For

all practical purposes, 700° will be found sufficient for the distillation; a temperature of 650° to 700° well kept up, yields the largest results as to the quantity of fluids obtained; and lower temperatures have been found to answer equally well, where super-heated steam thrown upon the materials has been used instead of, or as an adjunct to, external fire.

When substances are composed of only three elements —carbon, hydrogen, and oxygen—or mainly made up of these three, the nature of the change which they will undergo on the application of heat, depends to a great extent upon the ratio which the oxygen and hydrogen bear to each other. When these gases are present in the compound, in the proportion which would constitute water when united, a very low temperature will suffice to draw these elements together to form water, and thus deprive the carbon of its share of oxygen, leaving it as a dry, hard coke. Should the substance, however, be suddenly subjected to a very high temperature, the display of affinities would be somewhat different; for while, at comparatively low temperatures, oxygen prefers to unite with hydrogen rather than with carbon, at higher temperatures, the affinity of oxygen for carbon is more powerful, and thus less water is formed, and more of the oxides of carbon, carbonic oxides or carbonic acid: the hydrogen thus prevented from uniting with the oxygen, seizes an equivalent of carbon, and forms a carbide of hydrogen, which may be either a liquid oil or a permanent gas, according to the temperature at which it is produced.

But if the ratio of hydrogen to oxygen in the material was not in that proportion to form water, but in much larger proportion, then, when heat is applied, the excess of hydrogen seizes on the carbon and appropriates it, producing the oleaginous or gaseous carbides. Now the proportions of the three elements in which the carbon would be fully saturated with either of the other two, might be expressed thus:—

Carbon, 3	which by mutual union would form	Carbonic acid=	C O_2
Hydrogen, 3		Water=	H O
Oxygen, 3		Carbide hydrogen=	C_2 H_2

A greater proportion of carbon than that contained in the above relation would not tend to unite with the other elements, but would remain behind as the coke, or carbonaceous residue: when the hydrogen also increases, then carbides of hydrogen, richer in both elements than the formula given above, will be produced, rising to the ratio of C_{24} H_{26}, and even upwards.

The nature of the products then varies in proportion as oxygen or hydrogen preponderates in a mineral. In the former case, water and carbonic acid will be chiefly formed; in the latter, hydrogen compounds of carbon will predominate: when these combine at low temperatures, many atoms of each element unite with the other to form definite volatile, oily, and ethereal liquids; while at high temperatures it is chiefly as gaseous or carburretted hydrogen, it is thrown off; and thus to manufacturers of mineral oils, the question of suitable temperature for distillation becomes the all-important one.

But no matter how large soever the ratio of hydrogen and oxygen may be in organic substances when distilled in close vessels, the whole of the carbon is never taken up, and hence the residual coke or charcoal is a necessary result of dry distillation,

In this distillation, all of the oxygen compounds pass off first, the richest in oxygen having the start, and followed by others containing less, until the whole oxygen is removed, when the hydrogen compounds then are set free: thus, in the decomposition of wood in close vessels, the order of production is—water, carbonic acid, acetic acid, carbonic oxide; oils=compounds of carbon and hydrogen, with little oxygen; gas=carbon and hydrogen.

In the manufacture of charcoal by the destructive distillation of wood, the object is to get the greatest quantity of carbon left behind; every circumstance which would tend to remove more carbon than is necessary to unite with the oxygen present, is avoided; when wood is moist or fresh, when placed in the carbonizing oven or retort, steam is first produced, which passing over some portion of the wood in strong ignition, tends to be decomposed into oxygen and hydrogen, each of which uniting with some carbon, forms carbide of hydrogen, HC, and carbonic oxide, CO, and thus a less product of charcoal is the result; dry wood is therefore preferably used. But in the manufacture of oils, the object is not to obtain a large amount of coke, or residual carbon, but the reverse; hence, every circumstance which would tend to make carbon unite with hydrogen should be adopted. The admission of steam does this in the abstract, but the compounds so produced have not that polyatomic constitution which the mineral oils possess, and hence it cannot be affirmed that the formation of steam in the retort, or its admission during distillation, increases in a *direct manner* the formation of photogenic oils. But of its indirect benefit there can be no doubt, and it, in that case, probably acts partly by keeping the retort at a lower temperature, and partly by assisting to carry off the vapors as they are generated, and by thus relieving the pressure in the retort, tend to hasten the further evolution of the oils.

Organic substances containing much carbon are generally distilled for the following objects:

1. To obtain charcoal.
2. " vinegar.
3. " photogenic oils.
4. " gas for lighting purposes.

And for the economical manufacture of each, strict attention is required to the temperature at which the distillation is produced. The 1st and 2d objects are generally effected simultaneously; but the 3d and 4th cannot be profitably carried out along with the 1st and 2d objects; nor can Nos. 3 and 4 be carried on together without loss of either class of products—the temperature necessary to produce No. 3 being such as would ultimately decompose any volatile oil produced.

The temperature at which the separation of the constituents of organic substances takes place, involves a large theometric range, commencing with 300°, and running up to 2732° Fahrenheit.

The tendency of destructive distillation is to produce compounds possessing more simplicity of composition than the original substance, and capable of sustaining the higher temperatures at which they form, unaltered; so that, under the range of temperature indicated, liquids will be formed when the temperature is least, as at the commencement, and gases when the heat has arisen to the high point set down; and as in the lower ranges where liquids are produced, the effect of augmented heat within this lower range is to lessen the complexity of the compound by dropping or reducing its amount of carbon or of hydrogen, it is at the very lowest temperatures that the liquids containing the highest number of atoms of carbon and hydrogen will be found; and when the temperature arises to that of formation of gas, this gas (a carbide of hydrogen) is produced at the expense of the complex liquids formed at first, which give off some carbide of hydrogen and thus have their proportions simplified. Thus, let C_{14} H_8 lose C_2 H_2 or one equivalent of olefiant gas, and C_{12} H_6 remains; if two proportions of this latter, or C_{24} H_{12}, lose six equivalents of carbon by heat, C_{18} H_{12} remains; and if four equivalents of C_{12} H_6 or C_{48} H_{24} lose one equivalent of olefiant gas, C_2 H_2, one equivalent of marsh gas, C H, and 25 equivalents of carbon, there would remain C_{20} H_{21}; now the first supposition would show a probable formation of benzole C_{12} H_6 from toluene C_{14} H_8: the second the formation of cumene C_{18} H_{12} from the doubled atom of benzole: and the third, the formation of paraffin C_{20} H_{21} from a quadrupled atom of benzole.

The above, though not perhaps strictly representing the order of decomposition, serves to show the result of augmented temperatures, viz: the gradual loss of C H, and consequently the destruction of the polymeric isomeric hydro-carbons formed at low temperatures; and will, perhaps, also assist in showing what is desired to be enforced everywhere in this work, that the smallest range of temperature above that necessary to evolve or produce photogenic oils, is sufficient of itself to bring about their destruction.—*Antisell on Hydro-Carbon Oils.*

PRUSSIAN LAW FOR TESTING GAS-METERS.

Le Journal de l'Eclairage au Gaz publishes the following regulations for testing gas-meters in Prussia, which is done by the Government.

" MINISTERIAL DECREE RESPECTING THE STAMPING OF GAS-METERS.

"According to the terms of the decree of the 13th of May, 1840 (which orders that in all cases, when anything is sold by weight or measure, no sale shall take place in Prussia until the weights and measures be legally stamped) the supply of gas for lighting should naturally be placed under the same conditions since it is sold to individuals by measure, and they pay for it according to the quantity they consume.

"Therefore, to prevent the infringement of the beforementioned decree, gas for lighting, if supplied by measure, can only be sold by the cubic foot; and for measuring the quantity, meters that are legally tested and stamped must be employed.

"Those meters only will be permitted to be tested and stamped, which are constructed on the principle of a rotating drum partly immersed in water, or in any other similar liquid, and which fulfill all the conditions prescribed in the instructions given to the agents who are appointed to test them.

"Every meter must have inscribed on a badge or plate the number of burners it is calculated to supply, the name and the residence of the manufacturer, and also its own number in the order of manufacture.

"The capacity of the drum of the meter which serves to measure the gas must be calculated in Prussian cubic feet, and those meters only shall be stamped which have their capacities thus expressed.

"Nevertheless, the meters that are not constructed according to the foregoing measures may be tested, provided they are presented to the officers before the 1st of January, 1855, after which date they can be no longer admitted.

"The testing and stamping of the meters must be done in the provinces by a commission, or at Berlin at the testing-office, by a person appointed by the authorities.

"There shall be paid for testing a measuring drum of

⅛th of a cubic foot.....	0 thaler	15	silver groschens.*	
¼ " "	0 "	22	"	"
½ " "	1 "	00	"	"
1 cubic foot.....	1 "	10	"	"
1½ "	1 "	20	"	"
2 "	2 "	00	"	"
3 "	2 "	10	"	"
4 "	2 "	20	"	"

"If five meters of the same size are brought at the same time to be stamped, the charge shall be diminished one-third.

"For the re-examination of meters that have been previously tested, or which were found defective at a previous trial, only one-half of the above charges shall be made.

"In addition to the cost of testing, there must be paid to the director of the commission, or to the offices of this administration, for the minor charges of stamping and testing, the following fixed prices, which shall not be exceeded:

For 1 drum of	⅛th of a cubic foot,	0 thaler	10	silver gros.	
"	¼ " "	0 "	12½	"	
"	½ " "	0 "	15	"	
"	1 cubic foot.....	0 "	17½	"	
"	1½ "	0 "	20	"	
"	2 "	0 "	25	"	
"	3 "	1 "	00	"	
"	4 "	1 "	05	"	

"For the due execution of this decree, the royal administration will give the necessary directions to the testing commissioners, if there be any gas-works for public lighting within their jurisdiction, so that they may make known to the public, in the journals or other public papers, the decree which we have prescribed.

"The providing of the necessary apparatus for testing the meters, as well as of that mentioned in the instructions given to the testing commissioners, shall be undertaken by the royal administration, and the cost of them shall be defrayed from the first fees received; and in case that sum should not be enough, the deficiency shall be liquidated on the presentation of an extract from the accounts of the commission.

(Signed) "VON DER HEYDT,

"The Minister of Commerce and Manufactures.

"*Berlin, July* 10, 1853.

" INSTRUCTIONS TO THE AGENTS APPOINTED TO TEST THE METERS.

"To provide for the execution of the decree of the 10th of July, 1853, relative to the trial and stamping of gas-meters, the following instructions are given to the authorities charged with the testing of them:

"1. No meters shall be stamped but those constructed on the principle of a rotating drum made of plate tin partly immersed in water, or in some analogous liquid. These meters should be furnished with accessory apparatus, indicated by the subsequent articles 2 and 4.

"2. The essential part of the meter is the drum, turning on a horizontal axis, which should be completely enclosed within a tin case, hermetrically soldered, to serve, at the same time, to contain water and gas. A great portion of the drum should be immersed in the water, which should enter through openings at the sides, and fill it to the level of the water on the outside. The capacity of the drum which serves to measure the gas, should be painted in oil color or varnish on the cover; and the figures of the index, placed at the back of a glazed opening, should be perfectly visible. If the drum be made according to the directions of article 3 of the 10th of July, 1853, which will not become obligatory until after the 1st of January, 1855, the measurement will be expressed fractionally; for example, ¼ of a cubic foot or ½ a cubic foot, &c. If the drum be not so constructed, the measerement will be marked by decimals; for example, 0·243 cubic foot or 1·46. In the latter case the authorities charged with the testing must themselves inscribe the cubical capacity, if it has not already been previously done, without any additional charge.

"3. The dial of the meter is undoubtedly the most important part of the apparatus. The hands are put in motion by the rotation of the drum, and serve to register by the number of revolutions of the drum the quantity of gas which has passed in a given space of time, and the number of cubic feet supplied is thus regularly counted. During the revolution of the drum the figures of the dial pass from hundreds to thousands up to 100,000, and consequently indicate hundreds of cubic feet. To check a smaller number of cubic feet than 100, a plate or cylinder, turning horizontally, is placed on the right hand, above the last figures, where it must be seen. In meters for three lights the circumference of this plate or cylinder is divided into five; in those of larger size it is divided into ten equal parts, so that by means of a hand arranged for that purpose fractions of hundreds of cubic feet may be counted.

"4. The dial should be firmly fixed in the case of the drum. It should be covered with glass, so that the figures may be seen whilst the dial is protected from being fraudulently altered. When the meters are taken to be tested the dials should not be fixed, neither should the bands which connect them be attached, in order that they may be removed during the testing, and the figures be exactly regulated, and the working of the hands verified.

"5. The measurement must be given in Prussian cubic feet, under the pressure of an inch and a half of water.—A difference of 2 per cent. in the measurement may be tolerated.

"6. The measurement of the drum should be taken by means of atmospheric air. For this purpose a quantity of air that has been accurately measured is passed through the drum, and the figures on the dial must be examined to see if they agree exactly with the quantity of air intoduced.

"7. In the above mode of measurement a cubical measuring apparatus must be employed, the drawing and description of which are appended. To render this apparatus fit for testing, the bell which serves as a reservoir for the air is raised sufficiently above the water that the point of zero may be exactly opposite the hand; and, the stop-cock being closed, the pressure of the air is regulated by increasing or diminishing the counterpoise, so that the pressure-gauge indicates an inch and a half column of water.

"8. At the same time, the meter under trial (the dial being fixed at zero and the tin cover removed) is fixed

* The thaler is equivalent to about 72 cents, and the silver groschen almost to 2⅓ cents.

upon a horizontal table where it is placed in communication, by means of an India rubber tube, with the air-apparatus above described. The meter should be then carefully filled with water, by a tube provided for the purpose, until the fluid begins to flow through the opening below the water chamber, which is a sign that the level of the water within the meter is correct. When the water ceases to flow, the opening at the top is first closed, and afterwards the overflow, and a tube must be fitted into the outlet in the upper part of the case, to which it should be hermetrically sealed. When everything is thus prepared, the stop-cock of the air tube must be opened, until 20 cubic feet of air have passed from the bell of the apparatus into the meter, when the stop-cock must be again closed.

"9. If the meter be of the smallest size intended, viz., for three lights, this single experiment will be sufficient. It may be completed in less than a quarter of an hour, and when ended, the hands of the dial should correspond with the direct measurement, and the difference should not exceed two and a half per cent. in a cubic foot. When meters of larger size are tested, this experiment must be repeated several times, according to the capacity of the drum; and each time the bell must be raised, so that the point zero of its scale may be opposite the hand of the dial. Five-light meters require at least two experiments, in which 80 cubic feet of air should pass through the drum.*

"The experiment should be repeated five times, so that at least 100 cubic feet of air may pass during the testing, because in this manner correctness is more readily and more exactly obtained. That number of experiments will be also sufficient for meters for more than ten lights; they will require about half an hour. Nevertheless it is desirable, and in doubtful cases it is necessary, to allow more than the 100 cubic feet of air to pass through the meter during the five experiments, so as to be certain that the difference of 2 per cent. of measured air allowed by article 5 is not exceeded.

"10. The time occupied in the experiments is so regulated that the drum, in its effective working to produce a steady flame, should make from 100 to 120 revolutions in an hour; to diminish the time of the testing, the discharge tube should be opened, so that the revolutions may be as many as from 150 to 160 per hour.

"11. To expedite the operation of testing, several meters, not exceeding five, of the same capacity, may be tested together. The air used in the first trial of the first meter should pass through the second, and so on through all the meters that are tested together. For this purpose the meters should be placed according to article 8, in a line on a horizontal table close to one another, and after they have been all filled with water to the proper height, the apparatus for cubical measurement should be connected with the inlet pipe of the first meter, and that should be connected in the same manner with the second, by means of an India rubber tube, and so on to the third and to every other meter in connexion; the upper opening of the last one being furnished with a discharge pipe. As by this arrangement the air passes through each meter with a diminishing pressure, the drum of the last one will make several more turns to pass the same quantity of air, but the difference is so small that it need not be taken into consideration; it will not, indeed, be more, even when the pressure in the first and the last meter differs as much as an inch of water, than $2\frac{8}{8}$ in a 1000, or $\frac{1}{4}$ per cent., which does not amount to an eighth part of the difference allowed by article 5.

"12. If, after these trials, there appears to be a difference in the capacity of the meter exceeding the limits authorized by article 5, the meter must not be stamped, and one-half of the fees for testing, as stated in article 6 of the decree of the 10th of July, must be returned to the owner. Nevertheless, if by the trials that have been made the capacity of the drum has been exactly ascertained, in that case the size as indicated on the case must be effaced by the testing officers, and replaced by the correct figures; and if the meter has not previously had its estimated size marked upon it, according to the 2d article, it shall be inscribed by the authorities.

"In case the authorities show that there is no difference, or a difference less than that sanctioned by article 5, or when the exact capacity of the meter has been inscribed on it by the testing officers, then the stamping shall take place in thefollowing manner:

"In the first place the index box before mentioned shall be placed upon the meter and soldered by the testing officers in three places on its lower edge, so that it may be completly soldered on its return to the workshop; and in order that the exactness of the figures may be checked, the test stamp is impressed on one of these three solderings, which must be made with a sufficiency of metal. Furthermore, the tin case of the water-box must be stamped in two places; in one place with the royal eagle, and in the other with the private mark of the commission; and this part shall be soldered completely all round the outer edge. Lastly, the back part of the cover of the drum must be also marked on the edge by drops of solder, which shall be stamped with the royal eagle. The stamping should be done in such manner that half of the impression may be on one part, and half on the other part of two connected pieces, so that they cannot be separated without injuring the stamp.

"14. With every meter that is stamped, there shall be given to the owner a declaration of testing, for each meter separately, which declaration shall serve also for a receipt, according to a given form.

Berlin, 10th July, 1853."

* If there be room to fix a bell six feet high, a scale of five feet will give 25 cubic feet, and thus in four experiments 100 cubic feet will have passed through the drum.

REPORT
ON THE BRITISH CANNEL COAL-GAS,

SUPPLIED IN GLASGOW, LIVERPOOL, AND MANCHESTER.

The Watching and Lighting Committee of Glasgow having deputed Mr. Miller, their Inspector of Lighting, to proceed to Liverpool and Manchester to ascertain the illuminating power and cost of the gas supplied in those towns, that gentleman has made a report, of which the following is a full abstract:—

"In obedience to your instructions to me, to proceed to Liverpool and Manchester, and procure information respecting the gas, &c., I beg to report that I have done so, and would respectfully submit the following statement:—

I. ILLUMINATING POWER OF THE GAS.

"For the better understanding of this branch of the report, it may be as well to explain the different modes of testing the illuminating power of the gas usually practiced in the cities above named.

"In Glasgow, that prescribed by Act of Parliament is the method adopted generally, which is 5 feet of gas per hour, burned in an argand burner having 15 holes, and covered with a 7-inch chimney, contrasted with a sperm candle, six in the pound, and consuming 120 grains per hour.

"In Liverpool, 4 feet per hour, consumed by a flat fish-tail or batwing burner, contrasted with a candle as above, is the method adopted both by the gas company and the inspector of lighting, appointed by the corporation. In Liverpool, the gas company consider their gas equal to 23 or 24 candles, parliamentary standard. In February, 1857, the corporation inspector's book shows it to have been 23·5; and the average of nineteen experiments, from the same book, made from the 10th of June to the 23d of September of this year, gives 26 candles, parliamentary standard; but in both cases, by the use of a flat-flame burner, consuming 4 cubic feet per hour, reduced to 5 feet.

"In Manchester, as in Liverpool, the flat burner is used, consuming 4 feet per hour, and with a candle burning 120 grains per hour, and with such a test the gas is alleged to be equal to 22 candles, which, when reduced to 5 feet per hour, gives 27 5 candles.

"The following is the result of my own experiments:—

	Burners.	Ft. per hour.	Pressure	Parl	Stand'd.
"GLASGOW GAS-LIGHT COMPANY.					
Nov. 1, 10, 28.	Argand.....	5·33	11–10	26·71	candles
22, 28.	Fish-tail.....	4	"	30·35	"
"CITY AND SUBURBAN GAS-LIGHT COMPANY.					
Nov. 1, 10, 28.	Argand.....	5	10–10	26·71	"
22, 28.	Fish-tail.	4	"	32·77	"
"LIVERPOOL GAS.					
Nov. 14, 15.	Argand.....	2.9	2½–10	19·12	"
15.	Fish-tail.....	3	2–10	23·4	"
MANCHESTER GAS.					
Nov. 16.	Argand.....	4	6–10	22·45	"
16.	Fish-tail.....	4	"	28·1	"

"I may explain that, in regard to Liverpool, I could not obtain 5 feet of gas per hour through the argand burner. Such burner is there considered unsuitable for testing the illuminating power of their gas.

II. METERS.

"In Liverpool the gas is 3s. 9d, (90c.) per 1000 cubic feet *within* the parliamentary boundary of the city; outside of that limit it is 4s. 3d. ($1 02.) But in addition to the price of the gas, which is charged quarterly, there is a rent levied for the use of the meter, from 4s. per annum and upwards, according to its capacity; thus, for a 3-light meter, 4s. per annum; for a 5-light ditto, 6s.; for a 10-light ditto, 8s.; for a 20-light ditto, 10s.; for a 30-light ditto, 12s.; for a 45-light ditto, 16s., for an 80-light ditto, £1. 4s.; for a 100-light ditto. £1. 12s.; &c.

"To show the effect of the meter-rent on the cost of the gas, I will give three instances:—1. A dwelling house, yearly charge for gas only £2. 4s. 9.; rent of meter 6s., or about 13 per cent. on the price of the gas. 2. A merchant's office, yearly charge for gas 11s. 3d. only; rent of meter 4s., or about 35 per cent, on the price of the gas. 3. A shop, &c., yearly charge for gas £22. 16s. 5d.; rent of meter 6s. 6d., or about 6 per cent. on the price of the gas.

In Liverpool no discount is given and there are from 36,000 to 40,000 meters. In Manchester, meters are supplied to the consumer by the gas committee of the corporation at cost price. The prices are as follows:—

				Box.	Size of Inlet
2 lights to supply 5 flat-flame burners,			23s. 6d.	1s 8d.	½inch.
3	"	" 8 " "	31 6	1 8	½ "
5	"	" 15 " "	39 6	1 10	¾ "
10	"	" 30 " "	52 6	2 2	1 "
20	"	" 60 " "	73 6	no box	1½ "
100	"	" 300 " "	£14 5 9	"	3 "
150	"	" 450 " "	21 0 0	"	3 "

"The price of gas is at present 5s. per 1000 cubic feet in Manchester, but it is expected to be reduced to 4s. 6d. after the 25th of December next, only *within* the city proper, but not in the townships. A discount is given thus:

For 200,000 cubic feet, and under	400,000,	2½	per cent.
400,000 " "	600,000,	5	"
600,000 " "	800,00	7½	"
800,000 " "	1,200,000,	10	"
1,200,000 " "	2,000,000,	12½	"
2,000,000 " "	3,000,000,	15	"
3,000,000 " "	5,000,000,	17½	"
5,000,000 and upwards.....		20	"

III. SERVICE PIPES.

Both in Liverpool and Manchester service-pipes are provided free of cost to the consumer, except where they *enter private* property; but, as it is well known, dwelling-houses in English towns are, for the most part self-contained. The meter is placed on the ground, or sunk flat, *next* the street, and the service-pipe, in such cases, is from the main, outside the kerb-stone, to the meter. There is scarcely such a thing as *dwelling*-houses in flats piled upon each other for four or five stories, nor long courts and closes, such as we have, requiring long service-pipes. In some places such a plan as this has been adopted:—A row of cottages is built; the proprietor places a meter in a house at one end, in charge of the tenant there, from which a pipe is led, in the inside of the house, to the other end of the row. The meter is shut off at a certain hour at night, and the gas is charged by the proprietor along with the rent.

IV. SMALL CONSUMERS.

Neither in Liverpool or Manchester, are there such a number of small consumers as in Glasgow. In Liverpool there are probably 5000 under £1 per annum, to all of whom whose consumption is under 3000 cubic feet per annum, the price of gas is dearer than in this city, in consequence of the meter-rent. In Manchester there are from 30,000 to 50,000 small houses without gas. In Glasgow there are about 25,000, or more than a third of the whole, consumers by *meter*, each of whose consumpt is at or under 3000 per annum, and to whom the adoption of the Liverpool *price* of gas, and *plan* of charging for meters, would increase the cost of the gas above its present rate of 5s. per 1000 cubic feet. There are 70,000 meters in Glasgow.

V. PUBLIC LIGHTING.

In Liverpool, the gas company have a contract with the corporation to supply with gas, light, clean, and repair the *ordinary* lamps of the city for 71s. 7d. each—four feet of gas per hour to be supplied to each lamp. Parties are not agreed as to the price per 1000 cubic feet of gas supplied to these lamps. For Liverpool, the Metropolitan Gas inquiry makes it 4s. 1d. per1000 feet, or 59s. per annum, for gas, and 12s. 7d. for labour in lighting, relpairs &c., each lamp. The inspector of lighting makes the cost of gas 3s. 4d. per 1000 feet, or 48s. 3d. per annum, leaving for lighting, &c., 23s 4d. for each lamp per annum. If 3s. 9d. per 1000 feet which is the general price—be taken as the cost, this gives 54s. 3½d. for gas, and 17s. 8½d. for labour, repairs, &c., for each lamp per annum. In Manchester, where the gas works are in the hands of the corporation, there is a gas committee, who supply the gas only, and are allowed 1s. 6d. per lamp per annum, for ordinary repairs of lamp fittings; another committee control the number, character, situation, and also the lighting of the lamps. The estimated annual cost of each ordinary lamp in Manchester for, gas is 35s. 4d. Each lamp is estimated to consume 2.75 feet per hour, to burn 3,637 hours, and consume in that time 10,001¾ feet, with 10 per cent. added for leakage. The estimated cost per 1000 feet of gas for lamps is 3s. 6½d. Each lamp-lighter has from 70 to 90 lamps, and is paid 19s. weekly wages. The lamps are from 35 to 60 yards apart.

"In Glasgow the whole cost of the lighting department, from May, 1858, to May, 1859, is £9843. 2s. 3d. At 1st. Sept., 1859, there were of lamps of all kinds 8112—namely, 5533 jets, 1499 swallow-tails, and 1080 private lamps. Now, if the whole of those lamps are assumed to be single jets, and we add 1499 to 8112, we have 9611 lamps, by which to divide £9843. 2s. 3d., with £449. 14s. or 6s. for repairs, &c., of each of the 1499 lamps, with swallow-tail burners added—namely, £10.292. 16s. 3d., giving as the cost of each per annum £1. 1s, 5d. Add to this sum the price of three single jets, to make each lamp have the same quantity of gas as those in Liverpool, and we have 14s. 7d., × 3 + £1. 1s. 5d. = £3. 5s. 2d., as the cost of each lamp per annum, as against £3. 11s. 7d., or 6s. 5d., for each in favor of Glasgow. I need scarcely remind the committee that this result is obtained by including the cost of erecting lamps, which cost amounted to at least £1000 in the period embraced; and also about 100 lamps, such as those on the bridges, and private lamps consuming by meter.

"In Liverpool the 71s. 7d. does not include providing and erecting new lamps. I may add that the great number of lamps in Glasgow, compared with those in Liverpool, increases proportionally the expense for repairs, 6s. 10d. seems to be the expense of erecting, and repairing and lighting each lamp, exclusive of gas; but if £1000. 16s. 3d. be deducted, as the cost of providing and erecting new lamps, or 2s. 1d. per lamp, or 8s. 6d. *less* per lamp than the cost in Liverpool.

VI. INFERENCES FROM THE PRECEDING STATEMENT.

"(1.) The gas in Glasgow is two or three candles better than that of Liverpool and Manchester.

"(2.) The gas is cheaper in Glasgow than in Liverpool to consumers at and under 3000 cubic feet per annum, but is dearer to larger consumers, how much dearer can only be known by learning the quantity consumed, and rent of meter of each.

"(3.) The gas is cheaper in Glasgow than in Manchester, in consequence of consumers requiring to purchase meters, and because discounts do not take effect until 200.000 feet has been consumed.

"(4.) That the public lighting of Glasgow is more cheaply managed than that of Liverpool (to the extent of 6s. 5d. $1.54 each lamp]."

Mr MILLER in presenting the report to the municipal police committee, said that the following was a note which, with the sanction of the committee, he wished to add to the report:—

"In reference to Liverpool, I have the best authority for saying that, but for the union of the gas companies, the present price of gas could not have been profitably attained, and that said union was promoted or supported by the corporation.

"In regard to Manchester it is affirmed that the corporation there, realize upwards of £30,000 per annum of profit from the sale of gas, which shows, that under such a management, the price of gas could be greatly reduced."

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THERE ARE 20,000 CITIES AND TOWNS IN THE UNITED STATES, CAPABLE OF SUPPORTING GAS-WORKS, WHILE THERE ARE NOT 400 GAS-WORKS IN OPERATION IN THE WHOLE COUNTRY!!!

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THE
AMERICAN GAS-LIGHT JOURNAL.
ISSUED MONTHLY.

THURSDAY, MARCH 1, 1860.

Nothing very new or startling has transpired during the past month. The approach of Spring is always the signal for activity in those enterprises which depend for their development upon the means of locomotion which Winter impairs or entirely interdicts.

We have reports of a dozen new gas companies starting into existence, and several others projected. From data in our possession, we think the increase during the current year will be at least one hundred new gas-works, perhaps many more.

The Croton Aqueduct Department comes into the market, through our columns, for tenders for a quantity of water-mains of large diameter. This is but a flea-bite to what this huge department of our city government will require of this and other similar material. The rapid increase of the city towards the Central Park, and thence to Harlem, stretching nearly twelve miles in a northerly direction from its terminus at the Battery, will bring into speedy requisition a corresponding amount of means to meet that end. During February, a large amount of brass-work, including stop-cocks and fire hydrants, was contracted for.

Our city Gas-Light Companies are making such additions to their means of supply as the increasing demands require. The Manhattan Company's new laboratory is the most extensive and costly in the United States; it may be almost called a National Laboratory, so general is the dependence of minor gas-works upon the Manhattan Company for scientific experiments. The "old New York" is thinking of brushing up too, in the way of new offices, it being contemplated in the sacred retreats of Centre-street to move, to the spacious New Bowery, where they have fine lots unoccupied.

The table of English gas-works, published recently in London, consists only of a share-list, no information whatever being given of the extent of their business or the cost of the gas. If we can procure more desirable information respecting them, it shall be given to our readers.

Our photometrical apparatus being in the course of erection, the first use of it will be to test the various gas-burners in use, for which purpose we now invite samples for trial. Three burners of each size will be required. They should be sent under seal, addressed to the "*Rooms of the* AMERICAN GAS-LIGHT JOURNAL—*Gas-Burners for trial.*" Foreign as well as American burners will be received. The experiments will be made by gentlemen connected with our scientific staff, and the results published in this JOURNAL.

We have had a number of thermometers made for ascertaining the temperature of gas during the process of manufacture. These instruments are described by JAS. R. SMEDBERG, Esq., on page 136 of the AMERICAN GAS-LIGHT JOURNAL, and are considered indispensible to the successful management of gas works. These and all other instruments made for us will have the stamp of this JOURNAL, and will be guaranteed to be accurate. Orders for any philosophical instruments can be sent to us for execution.

We repeat our invitation to officers of gas-works and foreign merchants visiting this city, all of whom will receive a hearty welcome at the Rooms of the AMERICAN GAS-LIGHT JOURNAL, where desks are provided for their use, and where their letters should be addressed to secure their prompt receipt. Persons interested in gas affairs will meet others of the same kidney at almost every hour of the day. Many agreeable acquaintances have already been made here by those who have been known to each other heretofore only by the "trump of fame."

Mr. EDWARD BROOKE, of Fieldhouse, Huddersfield, favored us with a call before he left for England. He secured, while here, through his agent, Mr. McKEAN, 74 Broadway, the principal contract for the Brooklyn, N. Y., sewerage pipes, amounting to some twelve miles. A second contract for eight miles more was given out on 8th February, and a further contract for upwards of twenty miles will be given out this month. In speaking of the Scotch vitrified pipes last month, we referred to the British pipes generally, as compared with the American.

Mr. JOHN A. COWEN, of the old and respectable house of JOSEPH COWEN & Co., Newcastle-on-Tyne England, arrived lately and passed a few days in the city.

We visited, a day or two since, Messrs. J. K. BRICK & Co's. Clay Retort Works, at Brooklyn, N. Y., of which we shall speak more fully in our next. A bench of their Retorts will be set without tiles, during this month, in our basement, and drawings of them will be given in an early number of this JOURNAL.

The KEYSTONE WATER-GAS COMPANY call attention to their advertisement, on page 174 of this number, in which they offer Rights for sale.

Mr. FRED. C. KRAUSE has sent on exhibition samples of beautiful gas stoves for cooking and heating purposes, supplied with porous burners of his own invention. These burners are far superior to the ordinary gas-burners used in stoves. They equalise the distribution, and secure a thorough combustion of the gas, thus increasing and intensifying the heat. Mr. KRAUSE's advertisement conveys no idea of the beauty of his stoves, which are beyond comparison superior to any others we have seen. Country gas companies should encourage the introduction of gas stoves, as well for their economy and convenience as for the increase in the consumption of their product. Our next number will contain engravings and a full description of Mr. KRAUSE's invention.

THE CITIZENS' GAS-LIGHT COMPANY, of Brooklyn, N. Y., invite proposals for the erection of their Gas Works. Parties interested are referred to their advertisement.

We wish to call the serious attention of gas companies to Mr. WALTON's anti-freezing apparatus for gas mains and services. The right to use this apparatus can be secured for a mere trifle by the various gas works, while the castings cost but from fifty cents to a dollar each. Five dollars will cover the entire cost of the apparatus for works supplying fifty thousand feet of gas daily. Applications can be addressed to these Rooms. Mr. WALTON paid us a visit during the month, and explained fully the details of his improvement.

M. LE ROUX, Editor of the *Journal de l'Eclairage au Gaz*, gives notice that, owing to the translation of Clegg, 3d edition, into French, his proposed forthcoming work will be confined to portable, water, wood, peat and mixed, gas.

A further supply of Clegg has arrived; the number sold at our Rooms is nearly one hundred, besides a large number of other scientific books.

Persons in England having occasion to execute official papers for use in this State, are referred to the advertisement of JOHN MURRAY, Esq., solicitor, London, who is duly authorized by the Governor to take acknowledgments. Mr. MURRAY is also solicitor of the Union Bank of London.

THE UNIVERSAL LIME-LIGHT COMPANY.

This new Corporation has issued a prospectus in London, which has attracted much public attention. Among other statements put forth in this document and endorsed by eminent authorities, we find the assertion that the new Lime-light can be supplied to the public at one-half the cost of common gas-light. In another column an able exposition of the merits of this new illuminating agent is inserted in full. It has been prepared by A. H. Renton, the acting engineer of the company, and has been extensively circulated in England. In estimating the illuminating value of common small gas-burners, as compared with that of burners a hundred or a thousand times greater in illuminating power, we must not forget to include, as a very important element in our calculations, the immense advantages attending a concentration of light and a variation in its intensity such as are so easily secured and controlled by increasing or reducing the number of gas-burners. In lighting large buildings or streets, the lime-light will probably be found to exhibit some special advantages, but for domestic consumption and in such cases as require an equally distributed light of moderate intensity, it does not appear likely to be employed with so much advantage.

Several patents have been purchased by the company, from A. H. J. Bastable and W. Prosser, who have made improvements upon Drummond's mode of burning a jet of oxygen and hydrogen upon lime. These patents have cost the company over $70,000 in cash, and $218,000 in paid up shares. The following extract from Mr. Bastable's specification will be interesting to our readers:—

"This invention consists of improvements in that description of apparatus employed in the production of light in which jets of ignited gas (ordinarily a mixture of oxygen and hydrogen) are projected against a surface of lime or other suitable material, to which a slow motion is given.

"In apparatus constructed according to this invention, I enclose a column of lime or other suitable material in a case or guard, along which the column of lime or other suitable material may be impelled, the case or guard extending above as well as below the opening or place at which the jet or jets of flame strike the lime or other suitable material. At this opening in the case I fix or place wires in such manner that the lime or other suitable material upon which the flame or flames may happen to be impinging shall not fall down or out of the case when it happens to crack or decrepitate by the action of the flame. By these means I am enabled to prevent

much of the irregularity in the light which would be occasioned by the breaking away or decrepitating of the lime or other suitable material by the action of the flame, and which may (if not prevented) take place to such an extent as to deprive the jets of flame of the surface of lime or other suitable material upon which they are intended to strike, or remove such surface to too great a distance, so that light of the required volume and intensity will not be produced. The supporting wires may be made of platinum or other material not liable to be injured by the heat, and I place them in such positions that they shall not impede the motion of the column of lime or suitable material, and shall not obstruct the jets of flame; I prefer that the gases for each jet should be regulated by two cocks, one for each kind of gas; by these means, the regulation of the several jets of flame is made independent of each other, and capable of separate adjustment.

"The column of lime of other suitable material may be moved as heretofore by means of clock-work, or any other suitable means. When several gas jets are employed, I prefer to make the column of lime, or other suitable material, of a polygonal form, or to use two or more pieces of lime, or other suitable material, arranged polygonally, so as to present a proper surface or angle for each jet of gas orflame to impinge upon the number of surfaces and angles depending upon the number of jets used. As, for example, with three jets uniformly disposed around a centre, the column of lime, or other suitable material is made triangular in section, the angles of which may be rounded off or truncated, and the jets being directed to strike on the rounded or truncated angles. By this arrangement, a blending of the light produced by the different jets is obtained, whereas, if a cylindrical piece of lime or other material be employed, the light is thrown more strongly in some directions than in others. Nevertheless, in cases where a considerable number of jets shall be used, so that the space between any two of them is not greater than the width of the flame, a cylindrical column or piece of lime, or other material, may be employed.

"And in order that my said invention may be most fully understood and readily carried into effect, I will proceed to describe the drawing hereunto annexed.

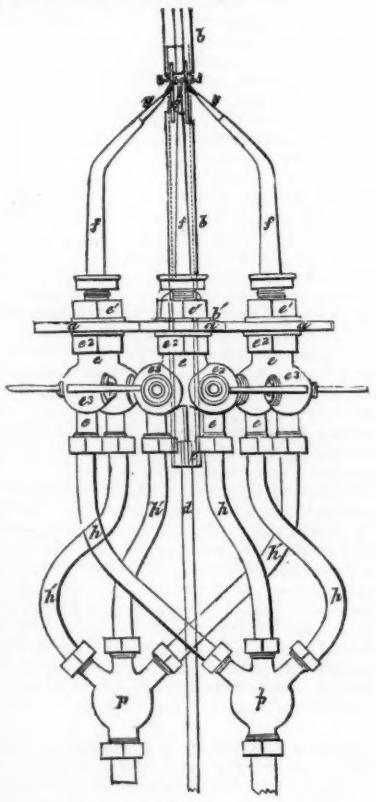


Fig. 1.

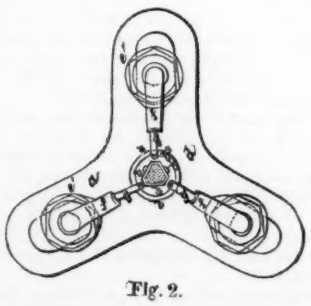


Fig. 2.

Figure 1 is a side view of part of an apparatus to be employed in the production of light, and which is arranged according to this invention; Figure 2 is a plan of the same, with the parts above the line I, I. Figure 1, removed. The apparatus shown, is intended for three equidistant jets; *a* is the table of the apparatus, having a circular hole through it at the centre, and three holes arranged round the central hole, and at equal distances from it and from each other. They may, if desirable, be slotted for the adjustment of the jets. In the central hole the case or guard *b* for the lime or other material is fixed; it is a tube of copper or other material made to the form of the pieces of lime or other material to be used with it, and having the collar *b*1 fixed on it, the projecting flange of which rests on the upper surface of the table, while its lower end passes through the hole, and receives a nut, *b*2, by which it is secured. The case or guard *b* it will be seen is made in two parts one below and the other above the points where the jets strike, and the two parts of the case or guard are connected by wires or strips, *b*3, of platinum or other material capable of sustaining the heat, but this complete division of the case or guard is only rendered necessary when the lamp is required to illuminate the space all aronnd the lamp. When the lamp is required to illuminate only a portion of the surrounding space, or in one direction only, the case or guard instead of being in two parts may be in one piece, a portion of it being cut away in the side next the jets to expose the lime or other material to the action of the flame, the lime being protected or guarded by wires or strips of platinum or other suitable metal between the jets of flame, and being of suitable form, as a flat segment of a circle, the lime or other material between the case or guard is formed into a piece or pieces of suitable shape and convenient length, and rests at the bottom on a rod, *d*, which is caused to rise gradually at a slow and regular speed by clockwork, or when mercury is employed to raise the lime or other material, then the case or guard is bent up into a ∪ form at its lower end, or a separate ∪ formed tube may be attached to it, and the mercury be allowed to run from a reservoir in a stream regulated by a stop-cock into one leg of this ∪ formed tube, causes the lime or other material, in the other leg to rise, floating on the surface of the mercury; I prefer that the lime or other material should rise at a speed of about an inch and a half in an hour. The upper end of the case or guard should be continued up to a sufficient height to contain the lime or other material which rises while the lamp is in use, or else a bowl or other receptacle may be placed at the top or back of the case or guard to receive the lime or other material as it rises above it.

The upper portion of the case or guard being slit lengthwise to admit of the free passage of the lime or other material in its expanded or decrepitated state when it has passed the flame, or a flat spring may be attached to the back of the case or guard so as to press the lime or other suitable material against the front of the tube, thus to preserve the distance between the jet or jets, and the surface of the lime. In cases where a supply of lime is required for a lengthened period, the lime or other suitable material may be attached to the surface of a cylinder having a spiral groove cut on its surface to receive it, and to which the lime may be securely fastened by any convenient mode. This cylinder, so charged with lime or other suitable material, is made to revolve on its axis, at the same time that its axis receives a progressive movement in the direction of the length of the cylinder; by these means a supply may be provided for many days consumption. For the supply of the gases, *e*, *e*, are branch pieces, the upper ends of which are screwed and project up through the holes in the table *a*, they are each furnished with two nuts, *e*1, *e*2, which bear respectively against the upper and under surfaces of the table; the pieces are thus secured to the table and can be adjusted vertically as may be required by making the holes in the tables slotted; the distances of the pieces, *e*, *e*, from the centre of the table can be regulated at pleasure; *f*, *f*, are bent pipes screwed on to the upper ends of the pieces *e*, *e*, and furnished at their ends with metal nipples or tips, *g*, *g*, which I prefer of platinum. The gas is caused to pass through wire gauze or other suitable appliance in the branch pieces, *e*, *e*, such as will render the appartus secure from explosion and as heretofore employed. In each of the branch pieces, or attached thereto, are two stop-cocks, *e*3, *e*3, to regulate independently, the one of the other, the quantities of the two gases employed as they pass to the jet. The two gases are led to the pieces, *e* by six pipes, *h*, *h*, *h*1, *h*1, two to each jet; the pipes, *h*, *h*, all communicate with the union piece, *p*, and the pipes, *h*1, *h*1, with the corresponding piece, *p*1, and the pieces. *p* and *p*1, are connected with flexible or other convenient gasholders, such as have been heretofore employed, and which contain the gases to be used.

"In cases where it is found convenient to apply the gases in a compressed state, a uniform discharge or supply to the jets from the containing vessels or gasholders may be effected by a clock movement and escape valve of suitable construction, which shall permit the required quantities of the gases to pass to the jets, the area of such valve aperture constantly varying as the pressure decreases in the gasholder.

"The gases usually employed are oxygen and hydrogen, but for this latter coal gas or carburretted hydrogen may be substituted with advantage where it can be procured. As it is desirable that the lime should not be exposed to the action of the atmosphere, which would speedily render it unfit for use, it may be kept (after it has been shaped) in a glass or earthen jar, close stopped, or in a box lined with tin foil or other impregnable lining, or the lime may be coated with an unctuous material, such as glycerine, linseed, or other oil, which, by closing the surface pores, prevents the absorption of moisture, and improves the illuminating quality of the lime.

"Having thus described the nature of this invention, and the manner of performing the same, I would have it understood that what I claim is the enclosing the lime or other suitable material used in such apparatus, as above mentioned, in a case or guard extending above as well as below the opening or place at which the jet or jets of flame impinge upon the lime or other suitable material, and placing a guard of wires at such opening, so that when the lime or material is caused to crack or decrepitate, by the action of the heat he otherwise, it may not fall down or out of the case or away from the action of the jet or jets of flame."

A rival company, under the title of the Fitzmaurice Light Company, has just been established. Among other patents purchased by them is one claimed by J. Cosscutt, issued about a year and a half ago. His plan is to prepare the lime by the addition of five pounds of sulphur per ton, and to prepare this mixture in a covered crucible or oven. There the temperature is raised to a red heat. The mixture, after being exposed for twenty-four hours to this temperature, is allowed gradually to cool, and is then cut into pieces for use. Our gas companies need not, we think, be under immediate alarm from these novelties; as for the reasons above mentioned and from other considerations, it seems probable that the most remunerative part of the consumption of gas is required for purposes for which the new illuminating method would be found less desirable and convenient.

PUBLIC LAMPS IN 1757.

Benjamin Franklin appears to have been the inventor of the present public lamps. In his Memoirs, Vol. 1, p. 194, it is recorded that the idea of public lamps was suggested by one Mr. John Clifton, who placed it in the front of his door, in Philadelphia, which impressed the people with the idea of lighting that city. The globe lamp was then used, but as no air holes were made in the bottom, Dr. Franklin says, "they were found inconvenient in these respects; they admitted no air below, the smoke therefore did not readily go out above, but circulated in the globe, lodged on its inside, and soon obstructed the light they were intended to afford, giving besides the daily trouble of wiping them clean, and an accidental stroke on one of them would demolish it and render it totally useless. I therefore suggested the composing of them of four flat panes, with a long funnel above to draw up the smoke, and crevices admitting air below to facilitate the ascent of the smoke; by these means they were kept clean and did not grow dark in a few hours as the London lamps do, but continued bright till morning, and an accidental stroke would generallly break but a single pane, easily repaired."

Having used these tin lantern frames for now more than a hundred years, we think it is about time for the old fogy lightermen to adopt the cast iron frames, which are advertised by three manufacturers in this JOURNAL. A gas officer, seeing them at our rooms the other day, was much struck with their durable appearance, and said they ought to be adopted at once.

DESTRUCTION OF THE NEW RETORT HOUSE

OF THE PHILADELPHIA GAS-WORKS, AT POINT BREEZE, BY A TORNADO.

The damage at the Philadelphia Gas Works, by the gale, on the 10th of February last, involved the destruction of the roof and side walls of the new Retort-House, just erected and not yet entirely finished. The building was 250 feet long, 57 feet wide, and about 52 feet high. The walls were constructed of red sandstone, three feet thick at the foundations, two feet at the base of the windows, and eighteen inches thick at the top, with double buttresses, three feet wide at the flanks and ends.

The window frames are of cast iron, secured to iron jambs, anchored into the foundation walls; and the roof of wrought iron trussed rafters, four inches wide and three-quarters of an inch thick, covered with slate on iron lath. One half of the building was sufficiently enclosed to have the bench of retorts finished and partly in operation. This end was enclosed in the usual rolling blinds in the windows, and temporary rough board doors. On the other half of the building, the workmen were engaged in fitting in the windows, part of which were open for this purpose, and part battened up with rough boards.

The gale had been increasing in violence from midnight of the 9th until sunrise of the 10th, and at seven o'clock it burst in the doors and some of the windows of this and other buildings of the gas works.

About five minutes past seven o'clock, the entire roof, weighing over 300,000 pounds, was swept away, carrying with it the greater part of the walls on which it rested; the fastenings being broken in every variety of way: in some places, the anchors were rent asunder; in some, the castings, which they held, were burst, leaving the anchors entire and in place; in others, the anchors tore up the masonry in which they were embedded; and in others again, the heavy iron columns between the windows were snapped off near their base, shewing conclusively that these several parts were so proportionate as to be of nearly equal strength, and thus to have given way almost simultaneously.

Since the catastrophe, the structure has been examined by a number of the most experienced builders, who express great astonishment at the extreme wrecking of a building, constructed of so great solidity and of the best materials.

With the exception of the castings, of which a large number are broken up, nearly all the materials can be used in reconstructing the building, the cost of which is estimated at about one-fourth that of its original constructions.

A number of workmen were in the building at the time it fell, none of whom were injured, except two, who were instantly killed, while trying to escape. The others, were uninjured, made no attempt to escape, but simply crouched among the falling ruins.

With regard to the cause of the disaster, it is impossible to form any satisfactory conclusion, unless it be that it lay in the track of a blast or tornado of irresistible violence, by which the numerous other buildings on the premises—some of them very much weaker than this—were left almost untouched.

BRIDGETON, N. J.—Only $22,000 of $50,000 capital in use, which is quite enough for size of town. Consumers increasing. Light gets into Jersey slowly. Works are well built, with iron retorts, and are in perfect order. No dividends yet—the wise course for a new and growing company.

WATERFORD, N. Y.—The works of this company are on the Aubin system, and have been in operation one year. They supply, at present, 102 consumers. The directors, we are told, have just made the first annual dividend of ten per cent. out of profits on hand in cash; and as they have on hand, paid for, a handsome surplus of gas-making materials, they have determined to lessen the price of gas for 1860, by allowing consumers an increased discount on their bills.

GAS EXPLOSION.—On the 10th of January a fire occurred in the building No. 395 Seventh avenue, occupied by James Connelly, dealer in old flour barrels. It originated in an explosion of gas, by which the gable-end of the building was forced out and thrown upon a small shanty occupied by a blacksmith. The building was completely demolished. Mrs. Connelly and a man and woman employed on the premises, were severely burnt. The damage to the building was about $300.

THE OXYHYDROGEN LIME-LIGHT.

BY. A. H. RENTON, C. E., OF LONDON.

There is not a more important subject, nor one more affecting the comfort and convenience of society, than artificial light. Whether viewed as applied to the ordinary domestic services, or to the more extended conveniences and requirements of every-day life, or to the many purposes in the arts to which it has now become an indispensable adjunct, artificial light must be regarded as so administering to the necessities of our existence, that it is of paramount importance to the public; and any improvement in its character or economy will claim to be hailed as a public boon; economy in many cases, though not as a rule, more especially conducing to its universal adoption.

So many circumstances have arisen in various departments of the arts, where either a powerful light is indispensable at any cost, or where economy is of the highest importance, that to combine these two elements successfully is a desideratum.

It is interesting to trace the progress of artificial lighting, from the primitive reed of the swamps or the pine torch of the wilderness, to the comparatively elegant and brilliant wax candle of the modern drawing room, or from the rude tallow urn or oil-lamp of the ancients, to its more diffused successor, the gas-light of modern days. Even this latter, brilliant as it is in any shape by comparison with its predecessors, has, from its earliest introduction to the present time, passed through many and varied phases of excellence before arriving at its present state of perfection.

Viewing artificial light in its every-day practical bearing, which is, after all, the only view of it calculated to interest the public, gas was doubtless the most substantial improvement of modern times, and has led to a complete regeneration of our social system.

By the introduction of gas into our streets and shops, a wholesome revolution has been effected alike in the comfort of passengers and purchasers; and crime, if not actually lessened by it, has been brought within the more complete control of the agents of the law.

It has contributed much to the convenience and elegance of our mansions, from its cleanliness and power, combining with those desiderata a very considerable degree of economy, the value of which has been illustrated by its effects.

If any EVIDENCE were wanting to confirm the necessity for still further advances in the production of an economical and powerful light, it is only necessary to point to many costly attempts which have from time to time been made, at the expense of many thousands of pounds, to achieve something in the shape of a new light, *as far surpassing gas* as gas has already surpassed all its predecessors.

Great and rapid have been the improvements of late years in our domestic lights, the requisites for which, as essential elements of their character, are economy, simplicity, cleanliness, safety, and power combined; and many very beautiful contrivances, with a view to this end, have resulted in the production of wax, sperm, stearine, and Palmer candles; the argand, carcel, solar-camphine, and other lamps, ingeniously devised to attain one great object, viz., economy and power, have, with varied success, met with the well-merited support of the public.

In many large mansions the aristocratic wax candle still holds its sway, though at great cost, and is superseded by gas only in exceptional cases; while for the more extensive applications of light to public buildings, shops, and external lighting, gas has been the only alternative, and even in our smaller towns has supplanted the modest oil lamps, which scarcely sufficed to do more than to render the darkness visible.

As great a change has been effected in the lighting of our streets as in the substitution of the well-organized police for the ancient venal sexagenarian guardians of the night, which with the rising generation are myths or *res incognitæ*. There is no doubt of the fact, that where light is abundant, crime will less abound, as it invariably shuns the light, because its deeds are evil.

The electric light, which, from its great intensity, was supposed to possess all the requisites for lighting purposes, has for some years past engrossed the attention of capitalists and others, who have expended large sums of money in vain attempts to render it the *ne plus ultra* of lights. But in spite of the great pains, labour, and money bestowed upon it, it has failed to realize the sanguine anticipations formed of it, as it possesses neither volume nor continuity, and is a very extravagant mode of obtaining the object in view. The trouble and uncertainty attending the use of the battery for generating the electricity, and the consequent effect upon the simple and vivid speck of light, renders it, from its inconstancy, unfit for the general purposes of lighting.*

As far as the problem of the continuity of the electric fluid is concerned, it has been successfully solved by the employment of magneto-electricity, but still leaving the indispensable elements of continuity, sufficiency of volume, and economy unsolved. Hence it is hopeless to look to the electric light as an effective agent for illumination, as it is deficient in those qualities without which it is impossible to produce an efficient light.

A light of great brilliancy was some years ago produced by combining a large volume of oxygen gas with a congeries of argand, or other burners, supplied with oil, and known as the Bude light, but, like others, was finally rejected, as disadvantageous in practice.†

For many years, even as far back as 1820, attempts were made to obtain a safe and intense light by the ignition or combustion of a ball of lime, in the united flames of hydrogen and oxygen gases. It was employed for microscopic purposes, and is stated to be equal to about 264 flames of an ordinary argand lamp (consuming the best spermaceti oil), each of which is equivalent to ten wax candles of four to the pound.‡

About the year 1826, Lieutenant Drummond, who was appointed to conduct the ordnance survey in Ireland and Scotland, first applied the lime-light, in the focus of a paraboloid, on lofty eminences, where the stations were usually placed, as it was of great importance in those operations to have certain and determinate signals, which could, almost under any circumstances of the weather, be seen at great distances; and by it he successfully connected the opposite shores of Ireland and England at or about Holyhead, a distance of about 64 miles. He used, on some of those occasions, oxygen gas and alcoholic vapour, but ultimately substituted hydrogen gas for the latter. In Scotland he obtained a most successful result on the summits of Ben Lomond and Knock Layd, a distance of 95 miles, thus demonstrating the practicability of adopting the lime-light for long distances.†

But even Drummond's comprehensive mind failed to overcome the chief obstacles to its introduction as a perfect lighthouse-light, although many valuable experiments upon it were made and exhibited publicly by him, and he is therefore entitled to great credit for his persevering pursuit of the subject, and for having thus pioneered the way for subsequent efforts to perfect it. As Drummond left it, its want of volume was one of its main objections, and its want of continuity was fatal to its employment for the purposes of steady and permanent lighting.

It was not, however, until after many and repeated failures to produce a permanent light from electricity, that the lime light was revived, and received a considerable share of attention from various persons, who, each contributing more or less important steps, advanced its progress with varied success. During the last 30 years, this light has been employed for illuminating the microscope used for the exhibition of dissolving views, &c. Amongst other applications, it has been used for upwards of twenty years in the theatres of the Royal Polytechnic Institution of London for their beautiful exhibitions.

In adapting the light to their requirements, a most valuable series of experiments were made at that institution, the results of which are herein given at length, by which the comparative power and value of the various known modes of producing artificial light is rendered clearly apparent. These results accord most accurately with those I have personally made, and show that the oxy-hydrogen lime-light is considerably cheaper than the cheapest of all other lights, viz., coal-gas; and bearing a most extraordinary relation to oil-lamps and wax candles, which latter are generally used as a standard of comparison.

In the application of the lime-light to the microscope and similar exhibitions, as well as to the blowpipe, there was no necessity for its continuance beyond the ordinary duration of a lecture and therefore the objections which were fatal to the light when applied to the many purposes of illumination did not apply; since, with them, permanence for for a lengthened period was scarcely, if ever, required. But, as a continual change in the surface of the lime is indispensable under any circumstances, in order to insure a regular and continuous light, sufficient steadiness may be obtained for a short period by very simple mechanical means, by which either a simple or spiral rotation is imparted to the disc or cylinder of lime upon which the flame impinges.

But the extensive and important applications of the lime-light proposed by the Lime-Light Company, entailed the necessity for providing for *many consecutive hours'* duration of the light with *unvarying intensity*, and it was therefore imperative to devise a remedy for those defects which had hitherto prevented the successful adoption of the lime-light; and they determined to avail themselves of Bastable's patented improvements, as fulfilling the required conditons, of which they had satisfied themselves by a course of numerous and rigorous tests.

Before describing these improvements it may be well to refer to the elements of a lime light, and the modes of producing them.

It was found by Drummond that many substances were capable of producing light in conjunction with gases, but that of all those which were available for the perfect combustion of the gases, chalk lime was the most suitable material for the purpose, and hence the name of "Lime Light" It was also the cheapest and most easily attainable in any locality. It was likewise found that several gases, compound of hydrogen, might be successfully employed in combination with oxygen gas, as well as pure hydrogen.

Pure hydrogen gas obtained from zinc, and diluted sulphuric acid, offers facilities in cases where carburetted hydrogen, as supplied by the gas-works, cannot be readily procured, but coal-gas, where available, is a most desirable substitute for the ordinary applications of the light.

The product resulting from the generation of pure hydrogen gas from zinc and sulphuric acid, is sulphate of zinc, which, from the extensive demand for it, as a material used in the manufacture of paint, &c., will always find a ready sale at a price which will leave the cost of the gas in a favorable contrast with other gases which may be used for the purpose.

In the year 1835, Mr. A. Gordon, C. E., patented a very ingenious and elegant process for generating hydrogen gas from zinc and sulphuric acid, which consisted in attaching the zinc to the rising portion of the gasholder, so that when it was fully charged, the zinc (which, had, during the generation of the gas, been immersed in the diluted acid, moving upward with it), emerged from the liquid, and consequently suspended the formation of gas, until by the consumption of the contained gas, the gasholder descended, by which the zinc became again immersed in the diluted acid, and the formation of gas was resumed. It therefore became a complete regulator of the generating process, and insured the utmost economy in the production of the gas. It is obvious that, by this arrangement, the average or continuous generation of gas will be precisely equal to the demand, and not intermittent, as the elements employed will be supplied only in the required quantities, but continuously.

Where it would be necessary to employ oil-gas, in localities where coal-gas is not available, a device similar to that which has been described for hydrogen has been successfully employed, the regulation for the supply of the oil to the retort being controlled by the ascent and descent of the gasholder.

The use of Leslie's coal-gas liquid offers a simple means of procuring this gas cheaply, as it is stated that its cost will be much less than that of ordinary coal-gas.

The generation of oxygen gas, which plays so important part in the production of this light, is one of extreme simplicity. It is obtained cheaply and easily, from a variety of substances, each existing in great abundance, viz.:, peroxide of manganese (black oxide), chlorate of potassa, nitrate of potassa, (familiarly known as saltpetre). Several other substances, the employment of which for this purpose is, however, precluded by their cost, as oxide of lead and red oxide of mercury; but it is improbable that these, as the other substances, will yield a residuum, which may become an article of ready and remunerative sale, in which case the cost of the gas produced from them will be reduced to a mere nominal value.

The peroxide of manganese requires simply to be placed in a retort raised to a red heat, when the oxygen gas is freely disengaged. So soon as the gas ceases to be evolved from the manganese (which can only be effected practically to the extent of about 11 per cent., although it contains at times 80 per cent.) the residuum, the deutoxide, or sesquioxide of manganese, may be drawn from the retort; and if thrown into water, or exposed at a high temperature to the action of the atmosphere, it will attract oxygen with great avidity, and this refuse becomes revivified, or resumes its former state of a peroxide, fitting it by this operation for a repetition of the distillatory process.

This peculiar property of the deutoxide of manganese (of rapidly absorbing oxygen from the surrounding air or other oxygenated bodies brought into contact with it) gives to this substance a great commercial value as a material for producing oxygen gas; for since the actual consumption of the manganese is thus limited by the quantity necessary to provide for the supply of gas during the time required for the revivification of the exhausted material, a comparatively small stock only will be needed to compensate for the unavoidable waste consequent on this mode of operating upon it.

In addition to this source of economy, the demand for the deutoxide of manganese for chemical purposes in glass-making, bleaching, and other processes in the arts, presents a means by which the residuum may be disposed of at a price which will leave the cost of the gas merely nominal. Thousands of tons are imported annually into this country, from the continent, for the before-named purposes, and hence the disposal of the residuum is a matter of certainty.

The chlorate of potassa is a substance which, though costly at first hand, is nevertheless a valuable material for the production of oxygen gas, from the facility which it affords to the operator. The comparatively low temperature required for its disengagement, and the rapidity with which it is produced, requires less attention and labor. Hence the cost of the gas is not so great as would at first sight appear, when contrasted with that from manganese. The residuum is chloride of potassium, or familiarly, muriate of potash, and is used in the arts.

The cost of the lime will, under proper arrangements, be extremely small, and may be next considered. Lime, being an article of such general consumption, and so readily procurable in almost any locality, and also from its being produced at a low cost, is scarcely worth estimating as an element in the cost of maintaining the light. The pieces of lime, which require to be shaped by proper

* See Stevenson on Lighthouses, p. 65.
† Idem, p. 66.
‡ Idem, p. 65.
§ Drummond on Light, Phil. Trans. for 1826, p. 324; and 1830, p. 383.

tools to the desired forms, being the work of boys at a low rate of wages, may be produced at a cheap rate; or as about 1½ inches is requisite for each hour's consumption, the cost per hour for each jet may be taken at ·03 of a penny. This value will be convenient for inserting in the cost of the light, when its maintenance is considered.

Having thus shown the modes of obtaining the elements of the light, it now only remains to describe the improved form of the instrument in which they are utilized, with some of the many important applications which are contemplated by the Lime-Light Company.

A patent was taken out in England, in the year 1858, for "improvements in apparatus employed in the production of light," by Mr. J. H. Bastable (a communication); and subsequently a patent for additional improvements had been obtained in the year 1859 by Mr. Prosser.

The object of the patents is to remedy the defects of the former applications of the lime-light. It has been invariably found, that although for short periods, for microscopes, and similar comparatively minor applications of the light, the adopted methods of applying the lime were with great care sufficient for the purpose, yet for the general purpose of lighting, the means were totally inadequate to the object; as the lime, when exposed to the action of the heat produced by the combustion of the gases, or the influence of the atmosphere, unavoidably became cracked or decrepitated, and in this ruptured state, having no support, fell away from the jet of flame, and either rendered the light inconstant or entirely useless; for the ignited gases, without the presence of the lime, possess no illuminating power whatsoever, though they are in that state most powerful agents for the destructive separation of refractory substances.

To effect the desired object of protecting the lime from crumbling away, and of insuring a practically unlimited supply, the simple expedient of enclosing the lime in a case or guard, both above and below the point of ignition, was resorted to, exposing only such a portion of its surface as was required for the action of the gases; and by giving to the lime so enclosed a movement within the tube, the retention of the ruptured portions of the lime was insured, until by simple means they were allowed to escape without detriment to the light, or were replaced by a fresh supply in as simple a manner as the cotton wick of an argand lamp, thus effecting with the perfect continuity of the light for any reasonable period (*a fortnight or more, if necessary,*) of time, the maximum brilliancy of the light.

So simple are the mechanical appliances for producing these results, that they fall as much within the compass of the ordinary attention bestowed on such objects as that required for an ordinary lamp.

The extreme purity of the light, eminently adapts it for interior illumination, as there is no evolution of deleterious gases or fumes (which from gas are so destructive to works of art, as pictures, furniture, and costly embellishments); nor any abstraction of the oxygen from the atmosphere, the requisite quantity for combustion being supplied by the instrument itself.

The light can be used either as a naked light, or in combination with the catoptric, dioptric, or the catadioptric systems, for lighthouses and ships of every class; for railway stations and signals, both fixed and moveable; for floating-light vessels or buoys in navigable channels; for bridges, wharfs, public buildings, factories, squares, and large and important thoroughfares; and by a judicious and compact arrangement of apparatus, its introduction into the interior of mansions where gas has not hitherto found access, will doubtless be insured. The application to street lighting, from its extensive and important character, has been reserved for the serious consideration of the Company, who have, however, so far matured their plans as to justify their anticipations of complete success.

Amongst other applications of the lime-light, it is from its portability eminently adapted for *military operations in the field*, both in the attack and defence of important positions. It is not less important as an adjunct to the *Coast-Guard Service*, both as an element of protection against aggressive surprise, and as a valuable addition to the already extensive arrangements for the safety of human life and property. And when, as at the present time, the protection of the coast is looked to as a grave matter for consideration as well as anxiety, and even of vital importance to the country, it will be found to be a matter in which the security of the coast is concerned.

The light has been rendered so portable by the employment of *compressed gases*,* that a coast guardsman can carry his charged lantern in his belt in the same manner as in the police force, the apparatus containing the supply of the gases being secured behind him as a knapsack The lamp may be fitted with a shade to mask the light when it is not expedient to display it.

This form of apparatus will be found convenient for reconnoitering parties, and for giving a full view even in the darkest night of the movements or positions of an enemy. For the more extended applications of the light to military purposes, it is proposed to place it, with its feeding apparatus, on a gun carriage, the gas generators, if required to accompany the lamp, being carried on the fore-carriage; the propriety of using the light in that form being an arrangement well understood by the service to which it would be attached.

In India, where night marches are indispensable, this form of light would be admirably adapted to the wants of the army, and be deemed a great boon; as troops are not unfrequently obliged to wend their way by the light of a few flambeaux, which are but a poor apology for what is so much needed for their security and comfort.

There are many applications of the light, where it is important that the gases should occupy the smallest possible space: in such cases it will be necessary to reduce their volume by compressing them, with suitable machinery, into strong vessels, under a force of several atmospheres, from which they may be used at any desired pressure by means of a simple self-acting regulator, which permits the gas to flow to the light in a uniform and constant stream without the necessity of personal attention. It is not, however, advisable to resort to this arrangement of apparatus, except in cases of necessity; such as, some lighthouses, buoys afloat, portable railway signals, table lamps, and moveable lights to be carried about the person, as in mines, for the coast, patrol, and military operations, as the cost of the gases is increased from the necessity of mechanical manipulation to charge the gasholders. It is, however, indispensable for the purposes enumerated, and is under the most complete control.

A not less important application of the lime-light is for the service of mines, whereby the safety of the miner from the effects of an explosion would be effectually secured, as the light may be enclosed, and protected from immediate contact with the surrounding atmosphere; for, unlike all other lights, it carries with it its own supply of oxygen gas, by which the combustion is maintained, instead of being forced to extract it from the air surrounding it. Hence there is no necessity for any direct communication with the atmosphere of the mine, and therefore the mixture and ignition of dangerous gases is effectually prevented.

In adapting the lime-light to the purposes of lighthouses, beacons, fairway buoys, shipping and railway signals, the military and coast guard service, the great penetrating power of the light, which is one of its peculiar features, must not be lost sight of, as being invaluable in hazy or foggy weather, when the ability to discern signal, lights, at even a small distance, is of incalculable advantage when ordinary lights are utterly useless.

The advantage of a light which should combine with steadiness, continuity and diffusiveness, purity, economy and simplicity, as well as the capability of being managed with ordinary attention, has been universally acknowledged, such features rendering it an object of national importance, and, therefore, having a claim upon the support of the public.

The qualities above enumerated are pre-eminently combined in the proposed lime-light, giving it an intrinsic value which no other light possesses, even could it be obtained at a great cost.

A single jet is found to vary in power in a much higher ratio than that of the consumption of the gases.

In a jet of medium size, say 1-20th of an inch in diameter, the power is equivalent to 40 argand, or 80 fishtail gas-burners, each consuming 5 cubic feet of gas per hour, or to 400 wax candles, of 4 to the pound, consuming from 1 inch to 1-2 inch per hour. But the power is limited only by the quantity of gas and lime consumed; and while its power can be indefinitely increased, it is so completely under control that it can be regulated with the same facility that ordinary gas admits of. The continuity of the light is rendered certain by *the protection of the lime*, and its economy is insured by the small quantity of gas and lime required for consumption. Any number of jets may be combined to form one lamp, and thus any desired power given to it, at the same time that the independent adjustment of each jet is provided for, so that the perfect combustion of the whole is effected.

When it is understood that so large a sum as £353,000 is annually expended on the coast lighthouses of the United Kingdom (as per return made in 1856, and laid before the House of Commons by Lord Clarence Paget, in April, 1858), and that of that sum no less than £208,000 was expended for maintenance alone, the necessity for adopting the most perfect light is obvious; since the cost of the simple elements of the light is trifling compared with the whole expense, which includes every incidental charge. And when it is further considered that for the same expense a lime-light (equally manageable with the ordinary oil system), and of at least *eight* times the intensity and power, can be supplied at the same cost, being at the same time free from many of the practical objections of the present mode of lighting, there cannot be a doubt of its desirability. The necessity for a superabundant supply of oil to the wicks, to prevent them from charring; the necessity for constant attention to the wicks, reflectors, and glasses; the constant attention to ventilation and supply of air for perfect combustion; the avoiding of gusts of wind through the air channels, and other minor attentions requisite to insure a constant and perfect light, as far as the system admits of, is by the employment of the lime light nearly, if not wholly, got rid of; so that the labors of the lighthouse attendants would be greatly diminished, and the service thereby better appointed, as depending less on personal attention. The same in all climates, there are no elements in the lime-light which would be affected by alternations of temperature, while the steadiness and constancy of the light is insured against the casualities of gusts of wind, &c., which seriously affect ordinary lights.

The following interesting tabular statement of the comparative value of light from various substances, is compiled from data derived from a valuable series of experiments, made at considerable cost of time and labor, by Professor Gardner (and attested by R. Longbottom, Esq., managing director), at the Royal Polytechnic Institution in Regent-street, London, and courteously permitted by him to be inserted herein. So useful as well as valuable a document will be appreciated by all who are interested in the subject of lighting:—

1. Description of Material.	2. Particulars of Burners, &c.	3. Value in Wax Candles, Six to the pound	4. Consumption of Material per Hour.	5. Units of Cost.	6. Cost per Hour for Light of equal Intensity.
			Ft.		d.
Lime light, with coal gas	Jet, 1-16 in. diam.	758·	7·2 oxy., 7·8 gas	9	1·00
Lime light, with hydrogen	Ditto, ditto	1167·	6·63 oxy., 12·4 hyd.	10	1·11
Argand gaslight	Ditto, 15 holes	20·18	6·50 cubic feet	17	1·88
Fishtail ditto	Ditto, No. 1	7·8	2·41 ditto	18	2·00
Ditto ditto	Ditto, No. 4	6·66	5·00 ditto	40	4·44
Moderator oil light	Ditto, 1 in. diam.	19·5	860 grains	42	4·66
Argand ditto	Ditto, 15–16 in. do.	14·15	697 ditto	97	10·22
Bude ditto	Ditto, ditto	151·25	4000 ditto	177	19·66
Wax candle ditto	Six to the pound	1·	130·6 ditto	599	66·55

* A misprint in the original report, where this figure is printed as 0·7, is here corrected. The No. 4 fishtail burner which follows, was evidently too small for the proper consumption of 5 cubic feet of gas per hour.—Ed. J. G. L.

In the above table, the various substances used to produce the light, are seen in col. 1. The respective intensities or values compared with a standard (a wax candle), in col. 3. The consumption of the respective materials, per hour, in col. 4. The units of cost, in col. 5; and the actual cost per hour for lights of equal intensity, in col. 6.

By careful reference to this table, it will be obvious that the lime light is the cheapest of all known lights.

During the last few months, several successful applications of the lime light have been exhibited to the public, which have uniformly elicited very general satisfaction, viz.:—

As a lighthouse-light (equal to 240 gas-lights), to the Corporation of the Trinity House, by their permission.

As an internal light (equal to 300 gas lights), at the Crystal Palace, by permission of the directors.

As an internal light (equal to 1200 gas lights), in Westminster Hall, by permission of the Chief Commissioner of Her Majesty's Works and Public Buildings.

As an external light (equal to 480 gas lights), in New Palace Yard, during the session of 1859, by permission of the Chief Commissioner of Her Majesty's Works and Public Buildings.

As an external light (equal to 480 gas lights), in the Speaker's Court of the New Palace of Westminster, by desire of the Chief Commissioner of Her Majesy's Works and Public Buildings.

As a transmitted light (equal to 480 gas lights), through the transparent clock face of the New Palace of Westminster, by desire of Sir C. Barry.

As an external light (equal to 300 gas lights), at the public hall at Wisbeach, by desire of the mayor.

As a ship's light (equal to 480 gas lights), on the quarter deck of the *Great Eastern* steam-vessel, by desire of the chairman of the directors.

As a public light, showing its application to street lighting (equal to 700 gas lights), on the New Westminster Bridge, by desire of T. Page, Esq., C. E.

As a beacon or coast light (equal to 90 gas lights), through a polygonal lens (by Chance, Brothers) of great power, on Westminster Bridge, by permission of T. Page, Esq., C. E.

Preparations are making, amongst other objects, for lighting Milford Haven Pier, New Ryde Pier, for its application to military purposes, for the Coast Guard, for steam and other vessels, for the New Westminster Bridge (at its opening), and for mining service: and the company are negotiating for several other important applications of the light, both on land and afloat, and is prepared to supply this beautiful and economical light both in a *fixed* and *portable* form, for any of the many purposes for which light is required, at a rate unapproachable by any other known light.

New Haven, Conn.—This company propose enlarging their works to the capacity of 1,000,000 feet per day, and for that purpose have procured the services of Joseph Battin, Esq., Gas-engineer, who constructed the works at the commencement, to furnish plans for the enlargement. Mr. Battin has erected 35 gas-works in different cities and towns in the United States. In 1844 he contracted to build the Albany Gas-works, which was the fifth gas-works erected in this country, and the first under individual contract for the whole work. He has also constructed the water-works at Buffalo, N. Y., Elizabeth, N. J., and Scranton, Pa. He has made several valuable improvements in the manufacturing and distribution of gas, some of which have been patented. He is the consulting engineer of the Newark, N. J., Gas-light Company at Newark, N. J., where he resides.

Cape Island, N. J.—This company supplies the hotels there, which are open but a few weeks only during the summer season. The population is entirely migratory, coming and going with the warm weather. Gas ditto.

* The gases have been employed in a compressed state in connexion with the lime light for many years past with great success, and is therefore no novelty or untried device.

PATENTS.

UNITED STATES.

26,884.—Thos. W. Carroll, of Baltimore, Md., for an Improved Self-lighting Lamp:

I claim the application of the lever and slide, as set forth.

26,888.—Thos. Connelly, of Philadelphia, Pa., for an Improvement in Burners for Vapor Lamps:

I claim, first, The combination of the annular perforated tube, A, with the outer vapor tube, G, its flared chamber, f, and inner vapor tube, D, when the said tubes are arranged in respect to each other and to the annular tube, A, substantially as and for the purpose set forth.

Second, The plate, m, attached to the inner tube, D, and arranged within the chamber, f, of the tube, G, as specified.

26,900.—Hervey W. Farley, of Hannibal, Mo., for an Improvement in Pressure Gages:

I claim the lever, L, and weight, W, or their equivalents, in combination with Bowden's pressure gage spring, S, in such a manner that the effect of any jar or external force upon the tube or spring, S, when in action, shall, in all positions of the spring, be counterbalanced or neutralized by the effect of the same jar or external force upon the weight, w, and the tube or spring be thus left to act undisturbed save by the pressure which is to be indicated, measured, or regulated by the gage, thereby securing a more perfect operation of the gage and constant correctness of the indicator.

26,910.—John K. Leedy, of Woodstock, Va., for an Improvement in Lamps:

I claim the arrangement of the alcohol lamp, B, the oil lamp, D, and the water cup, E, said cup being provided with one and the lamp, D, with two independent tubes which pass through them; the cup being situated above the lamp, D, and connected with it by means of a steam pipe, d, which passes into the tube, g; the whole being used substantially as and for the purpose specified.

26,927.—Wm. Rice, of Philadelphia, Pa., for an Improved Steam Generator:

I claim the box, G, its perforated wire gauze plates, f and h, the annular double cone-shaped gas chamber, H, its annular perforated gas tube, K, and the double cone-shaped chamber, L, when the whole is combined with, and arranged in respect to, the inner casing, C, and outer casing, A, and vents, x x, of the generator, as and for the purpose set forth.

26,928.—H. H. Richardson, of Barre, Vt., for an Improvement in Water Wheels:

I claim graduating the respective streams of water and projecting the same upon the buckets from chutes, of substantially the within-described shape, when the said chutes are so combined with the pivotted gates, h k, as to obtain the maximum of effect, substantially as described and for the purposes set forth.

In combination with the above-mentioned form of chute and gates, I also claim constructing the bucket wheel with the branching arms and disk-shaped floats, substantially in the manner and for the purpose set forth.

26,931.—George W. Robertson, of Philadelphia, Pa., for an Improvement in Hydrants:

I claim dividing the space between the casing of the hydrant and the water pipes into two chambers by means of the partition, h, the upper chamber terminating in a plate, g, and filled with a non-conducting material, and the capacity of said chamber being increased by means of the larged bore, f, and space, f', while the lower chamber formed between the partition, h, and the bottom board, k, contains no non-conducting material, but is fitted with an adjustable face board, a': the whole being constructed in the manner and for the purposes set forth.

26,937.—Reuben Tower and Geo. E. Tower, of Ashtabula, Ohio, for an Improved Water Gage:

We claim the gage composed of a vessel, C, suspended on springs and connected with a boiler by flexible pipes, D E, and with an index by a rack and pinion, or their equivalent, and operating substantially as described, to show the condition of the water level in the boiler.

[This invention consists in a closed vessel suspended by springs and connected with the boiler above and below the proper water level by flexible pipes, and connected by a rack or pinion, or other equivalent means, with a suitable index. The water in this vessel being always on a level with that in the boiler, causes the vessel to fall and rise by the increase and diminution of its quantity as the water rises and falls in the boiler, and so to operate the index and shew the quantity of water in the boiler.]

26,944.—Isaac Edelman [assignor to G. W. Edelman], of Philadelphia, Pa., for an Improved Water Closet:

I claim the arrangement of the three-way cock, I, having its plug central with the hinge of the lid, J, the vessel, N, and pipes, K L and M.

Second, The tube, P, with its notched end, in combination with the plate, Q, arranged within the basin, as set forth, for the purpose specified.

26,952.—George Neilson, of Boston, Mass., [assignor to Holmes, Booth & Hayden, of Waterbury, Conn.], for an Improvement in Lamps:

I claim an improved lamp cone or deflector, as made with its lip or flanch corrugated or formed with ridges to support the chimney, and not only form air passages underneath its lower edge, but to direct and insulate the several currents under the chimney, as stoted.

And in a cone or deflector so made I claim constructing each chimney-supporting corrugation concave on its underside, and with a closed outer end, as specified.

26,953.—George K. Proctor [assignor to himself and G. H. Stickney], of Beverley, Mass., for an Improved Lamp-lighting Device:

I claim the partially rotating and yielding plate, E, operated by the spring, D, or its equivalent, and attached to the shaft, C, in connection with the hook, j, also attached to shaft, C, the catch, n, on lever, G, and the match-holder, e; the latter being arranged relatively.

26,964.—W. W. Batchelder, of New York City, for an Improved Method of Lighting Gas by Frictional Electricity:

I claim attaching the electrometer to the gas fixture, substantially as and for the purposes set forth, meaning by gas fixture, that part of the gas-pipe or conductor which is in proximity to the burner, and to which the burner is attached, whether it be a bracket, drop light, chandelier, or stand, or other analogous fixture.

I also claim connecting the electrometer with a stop-cock, so that the act of turning the same to "let on" the gas, shall bring the electrometer with action as set forth.

26,965.—C. F. Baxter, of Boston, Mass., for an Improvement in Filters:

I claim operating the movable diaphragm within the globe, substantially as described and for the purpose set forth.

26,967.—G. Colhoun, of Philadelphia, for an Improvement in Ventilators:

I claim the inner and outer receiving cones, C D, elbow pipe, B, and flaring discharge pipe, F, when the whole is consrtucted, arranged and combined, substantially as and for the purpose set forth.

26,983.—A. Geiger, of Dayton, Ohio, for an Improvement in Burners for Vapor Lamps:

I claim making the cone piece, I I (which contains the non-conducting cork), with a break in the metal at the upper end of the cone piece between I I and B2 B2, this space being occupied by a ring of cork instead of the metal, so that the heat of the burner and cap may not be conducted down the tube, I I, substantially as set forth.

26,994.—Nikolas Hotz, of Trenton, N. J., for an Improvement in Nozzles for Hose Pipes:

I claim, as a new article of manufacture, a hose nozzle constructed as set forth.

26,995.—John Keane, of New York City [assignor to himself and W. H. Bartholomew, of same place], for an Improved Water Closet:

I claim the auxiliary lever, f, operating the cock or valve that supplies water to the closet, when combined with the pan lever, d, and pull, e, substantially as described.

27,027.—Henry B. Barber, of Scott, N. Y., for an Improvement in Devices for Raising Water:

I claim the gears in combination with the clutch, two-armed lever and beveled or cam shaped pins, P P, substantially as described, for the purpose of automatically changing the motion of the pulleys, H H', when the buckets are emptied; the whole being constructed to operate substantially as described for the purposes set forth.

THE MOTION OF GASES.

[*Continued from page 153 of the American Gas-Light Journal.*]

16. *Changes of volume and density due to variations of external pressure, the temperature of the gas remaining constant.—Law of Mariotte.*

The extremely simple law which governs the relation between the volume of a gas and a varying external pressure, was discovered independently by both Boyle and Mariotte, but is more generally known as the *Law of Mariotte*. It was ascertained by these observers that, under an increasing external pressure, the volume of a gas diminishes in precisely the same ratio that the pressure increases,—that under a decreasing pressure the volume increases in the same ratio as the pressure diminishes. Thus, if the volume be V under a pressure p, and if the pressure be doubled, tripled, etc., the volume will become one-half, one-third, etc., as illustrated in the following series of given pressures and resulting volumes:—

Pressures	p,	$2\,p$,	$3\,p$,	$4\,p$	$n\,p$,
Volumes.....	V,	$\frac{1}{2}\,V$,	$\frac{1}{3}\,V$,	$\frac{1}{4}\,V$....	$\frac{1}{n}\,V$;

So that a volume V under a pressure p, becomes one-n-th of V, under a pressure $n\,p$.

In order to express these relations in convenient formulas, let us suppose that a certain quantity of a gas under an external pressure p_1 has a volume V_1 and a density d_1; and let p represent a new presure greater or less than p_1, for which the corresponding volume and density become V and d; then, by the preceding conclusions, we shall have

$$[12]\quad \frac{V}{V_1} = \frac{p_1}{p};\quad V = V_1\frac{p_1}{p};$$

or, since the density of a gas varies inversely as its volume, we also have

$$[13]\quad \frac{d}{d_1} = \frac{V_1}{V};\quad d = d_1\frac{V_1}{V};$$

and by comparison of [12] and [13]

$$[14]\quad \frac{d}{d_1} = \frac{p}{p_1};\quad d = d_1\frac{p}{p_1}.$$

That is, in general terms, *the volume of a gas varies inversely as the external pressure, or the density varies as the pressure;* either of which, since one is but a consequence of the other, may be taken as the enunciation of the law in question.

17. The law of Mariotte, as thus defined, has been verified through a wide range of varying pressures, both increasing and decreasing, with certain restrictions to be now mentioned.

First—In respect to vapors or other easily condensable gases, it has been ascertained that, while the Law of Mariotte obtains for all degrees of expansion, it fails completely during compression, whenever the pressure upon the gas at a given temperature approaches that at which *condensation* begins; for every addition to the pressure beyond this limit tends only to the reduction of the gas to the liquid state. Still, we may regard the Law of Mariotte as applicable to vapors, provided only the entire range of varying pressures be kept below that pressure at which condensation would commence for any given case.

Secondly—Certain discrepancies have been noticed in the results of experiments in apparent violation of the Law of Mariotte. Thus, instead of the density being found to vary simply as the pressure, in accordance with this law, it has been observed in certain cases to *vary less than the pressure;* that is, the density instead of varying as the first power of the pressure, has been found to vary as a power whose exponent is less then unity; or instead of the simple relations [14]

$$\frac{d}{d_1} = \frac{p}{p_1} = \left(\frac{p}{p_1}\right)^1,$$

these cases appear to require the relation

$$\frac{d}{d_1} = \left(\frac{p}{p_1}\right)^{\frac{1}{r}};$$

in which r is some number greater than unity. This deviation from the Law of Mariotte appears to be due to the *action of heat within the gas*, independently of any variation of the external temperature; and it is a matter which is entitled to claim a little further consideration at this stage of our inquiries.

18. *Relative influence of gradual and sudden changes of density upon the temperature of a gas.*

It is doubtless known to very many persons, that a sudden compression of atmospheric air is attended by the evolution of *heat;* a fact which is well illustrated in the use of a little instrument called a *fire syringe*, which permits one to ignite a bit of tinder by a sudden movement of the piston, momentarily compressing the air below it to a small fraction of its original volume. And the correlative is not less true, although possibly not so generally understood,—that a sudden expansion of atmospheric air is accompanied by the production of *cold;* an illustration of which may be had in the experiment frequently seen in the physical lecture room, of a sudden rarefaction in an air-pump receiver, resulting in the formation of a fog of condensed vapor, with a fall of temperature which may be indicated by a thermometer; to which may be added the more striking experiment of the discharge through an orifice of highly condensed air, with the production of a cloud of snow from the congelation of aqueous vapor contained in the escaping air, suddenly expanding into a greatly larger space.

These facts warrant us in concluding that, under the influence of a variable external pressure, any sudden change of volume involving a corresponding change of density, may result in a change of temperature in the gas, even while the external temperature remains the same;—an elevation of temperature if the density be increased, and a depression of temperature if the density be diminished. And, inasmuch as these thermal changes clearly have their origin in changes of density, it follows that any cause capable of developing the one must as certainly determine the other.

Still, in practice, it freqently happens that we fail to perceive any sensible change of internal temperature even after effecting a considerable change of density in a gaseous body; a result which, indeed, generally obtains whenever the change of density is *gradually*, not suddenly, developed. This, however, cannot be considered in the light of an exception to the conclusions of the preceding paragraph, but rather as a consequence of conditions more or less favorable to a *continuous restoration* of thermal equilibrium. Such conditions are practically presented, when, in addition to the use of good heat-transmitting materials in the confining vessel, the changes of density in the gas are effected so gradually, that the resulting changes of temperature are equilibrated as they arise without sensible evidence of their occurrence.

Although, therefore, there is in reality no difference save one of degree in the thermal effects resulting from changes of density, yet a practical distinction must be made between the two following cases:—First, gradual changes of density without sensible thermal changes. Secondly, sudden changes of density with sensible thermal changes.

THE TENSION OF A GAS DURING A STATE OF EQUILIBRIUM, OR MOTION.

19. It has already been indicated (Sec. 14) that the elastic force, or tension, considered as the resultant of molecular forces in the gas, is a reaction from the interior equal and opposite to the external pressure, the temperature remaining unchanged; and it was also shown that the tension is susceptible of change with a varying temperature. Now, consistently with the state of quiescence or equilibrium which we are at present considering, it is at once obvious that, whether dependent on variations solely of pressure, or of both temperature and pressure, *the tension is always equal and opposite to the actual external pressure.* Thus, a column of Mercury in the barometer (Sec. 4) balances the tension of the air outside, and if the latter become greater or less, then the former lengthens or shortens, always adjusting itself to perfect equality with the varying tension of the air.

While, therefore, there is of necessity a perfect equality between the tension of a gas and the external pressure, during a state of equilibrium, it is equally obvious that any inequality between these opposing pressures must give rise to *motion* in the direction of the greater pressure. Reserving, however, all consideration of the state of motion for the sequel,—until we shall have completed a sufficient preliminary study of the laws of equilibrium,—we readily perceive from the preceding observations that the tension may always be represented by the numerical value of the external pressure, and *vice versa.*

In practice, the observed datum is naturally the tension, which is ordinarily balanced by a column of some liquid, as mercury or water, whose weight, while equal to, and a measure of the tension, represents at the same time the external pressure. Now, if p_1 and p be two different tensions measured by columns of the same liquid whose respective heights are h_1 and h, and if w be the weight of a cubic inch of the liquid we shall have, as in Sec. 10

$$p_1 = wh_1,\ p = wh;$$

or by division of the equations

$$[15]\quad \frac{p}{p_1} = \frac{h}{h_1};$$

hence, for greater convenience the ratio of pressures or tensions may always be replaced by the equal ratio of *pressure-heights* of the liquid used in measuring the tensions.

We now proceed to find the formulas for the tension of

a gas in the two practical cases; first, of a gradual change of density under a variable external temperature; secondly, of a sudden change of density under a constant external temperature.

THE TENSION OF A GAS RESULTING FROM GRADUAL CHANGES OF DENSITY UNDER A VARIABLE EXTERNAL PRESSURE.

20. We have from Sec. 15 (of the February number) the formula [6]

$$V = [1 + e(t - 32)]\ V_0\ ;$$

which, it may be remembered, gives the change of volume suffered by any gaseous body during a change of temperature from 32° to t° Fah., the external pressure being supposed to remain constantly the same. Let it however be supposed that the pressure, instead of remaining constant during the thermal expansion, also undergoes a change, taking a value either greater or less than the initial pressure. Then it is evident that the volume represented by the first member of [6] must take a value different from V, as for example, V^1. If, now, we place p_0 for the initial pressure and p^1 for the new pressure, observing that as the pressure varies from p_0 to p^1, the volume changes from V to V^1, we must have by the Law of Mariotte, [12]

$$\frac{V^1}{V} = \frac{p_0}{p^1}\ ;\ \text{or}\ V^1 = V\ \frac{p_0}{p^1}\ .$$

Substituting the value of V from [6] in the last equation, and we obtain

$$V^1 = \frac{p_0}{p^1}\ [1 + e(t-32)]\ V_0\ ;$$

or omitting accents we have

$$[16]\ V = \frac{p_0}{p}\ [1 + e(t-32)]\ V_0\ ;$$

from which, knowing the volume V_0 of a gas at a temperature of 32° Fah., under the pressure p_0, we may obtain the volume V at a temperature t under a pressure p.

Hence, also, since the densities are inversely as the volumes we shall have from [16]

$$[17]\ d = \frac{d_0}{p_0}\ \frac{p}{1 + e(t-32)}\ ;$$

And, accordingly, if we solve both [16] and [17] in respect to p we shall have

$$[18]\ p = p_0 V_0 \frac{1 + e(t-32)}{V} = \frac{p_0}{d_0}[1 + e(t-32)]\ d\ ;$$

so that, knowing the change of volume or density, in addition to the change of temperature from 32° to t°, we are able to compute the resulting tension.

STEALING GAS.—On Saturday, February 18th, a man named James Mulverhill, who keeps a drinking saloon in the Bowery, was arrested on a charge of using the gas of the Manhattan Gas Company, without paying for the same. The accused, it is alleged, introduced the gas into his premises by a pipe connecting with the main pipe, and had been using it in this way for some time, without the knowledge or consent of the company. This is what the Widow Bedott would call the "squintessence of meanness." He was taken before Justice Quackenbush, who held him in $500 to answer the charge.

EAST NEW YORK, N. Y.—This little town on Long Island will entertain propositions for lighting up with gas.

HERRING'S SAFES.—The attention of Gas Light Companies is called to S. C. Herring & Co.'s advertisement of safes. We have often been surprised to see the valuable records of Gas Companies exposed to fire by standing in wooden racks.

JACKSON, MICH.—Have just declared a dividend of 5 per cent.

WOOD GAS.—From an accurate analysis and photometric examination of wood-gas, taken from the Philadelphia Gas Works, made by Professors Wolcott Gibbs of New York, and F. A. Genth of Philadelphia, and reported by Mr. Cresson in 1857, the following results were obtained. They examined two varieties of gas, one made from old field pine, and the other from small second-growth oak.

	Pine.	Oak.
Specific gravity,	0·663	0·580
COMPOSITION.		
Hydrogen,	32·71	30·44
Light Carb. Hydrogen,	21·50	33·12
Cbf. gas and hydro-carbonic vapors,	10·57	6·46
Carbonic oxyde,	27·11	26·11
Carbonic acid,	4·90	0·48
Oxygen,	0·66	....
Nitrogen,	2·55	3·39
	100·00	100·00

Their illuminating power was found to be over 26 candles for a 5 foot burner. A subsequent series of photometric trials of wood-gas, previously passed through a long pipe exposed to a temperature of 15° F., gave an average of 18.3 candles from a 4 6-10 ft. burner.

The conclusion arrived at by other gentlemen was, that wood-gas in illuminating power is fully equal to the average of coal-gas.

CORRESPONDENTS' COLUMN.

PALMYRA, N. Y., Feb. 11, 1860.

J. B. MURRAY, ESQ.:

Dear Sir:—In the AMERICAN GAS-LIGHT JOURNAL of February 1st, on page 157, you say that your attention has been called to the price charged by our company, viz: $3.50 per 1,000 feet. I will call your attention to our Rules and Regulations, and then you will see what we charge and for what.

There is no misrepresentation on our part. Our consumers understand it. It is for a matter of convenience.

Respectfully yours,
S. JACKSON, Supt.

The following is the extract from the Rules and Regulations referred to:

The price of gas shall be at the rate of three dollars and fifty cents per *standard*. The *standard* to afford 200 hours for a 5 foot burner, or 250 hours for a 4 foot burner, and in the same proportion for larger or smaller burners. The standard is equal to one thousand cubic feet of ordinary coal gas.

We do not for a moment believe that the Palmyra Company intended to misrepresent, still there is a gas world outside of that town, who scan closely and compare the prices charged by each company, and without an explanation about these particular meters, other rosin-gas companies would rest under the imputation of overcharging. What we say is, and we insist upon it, that no meter manufacturer has a right to make an instrument to indicate a false measurement. If a meter can be made to register double, it can be made to register one-half the gas passing through it, and such a policy on the part of a gas company or meter manufacturer must eventually injure them. The statement made to us by the Palmyra Company of $3.50 as their price per 1,000 feet, as understood by the coal-gas standard, was not correct. We shall alter it to $7 in our tables.—ED.

——— GAS WORKS, Feb. 6, 1860.

Editor of the AMERICAN GAS-LIGHT JOURNAL:

Have you any work in your library, or do you know of any, that gives any information on the subject of the actual or probable duration of cast-iron gas-mains, wrought-pipes, gas-metres, &c.; and on the subject of the judicious financial management of gas works generally. As, what percentum of the profits should be set apart annually to meet contingencies or depreciation, &c.? It appears to me a work of this kind would be of great value to a young company desirous to do exact and equal justice, between present and future stockholders, as the managers cannot know, without such information, how much the annual loss from wear and tear would be.

There is a difference of opinion in our board of managers, as to the proper amount thus to be set apart annually. If you can render us any assistance, without too heavy a tax on your time, it will be gratefully acknowledged by

Yours, very truly,

Will some of our readers give their "experience" on these subjects? We have answered the questions in part, but they are of sufficient importance to receive further elucidation.—ED.

For the AMERICAN GAS LIGHT JOURNAL.

THE DETERIORATION OF COAL GAS.

I observe that H. K. S. suggests a solid core to the gas holder tank, as a means of preventing the depreciation concerning which so much has been talked, and so little *said*, lately. Your correspondent overlooks Dr. Torrey's formula (AMERICAN GAS LIGHT JOURNAL, Aug. 1, 1859), and the fact that after the water has reached its normal point of saturation, its subsequent absorptive effect is measured by and due to the evaporation which occurs over the surface of the annulus of water between the gas holder and the tank wall. A 'decomposing' retort will far more persistently and efficiently thin down good gas, than will a few gallons of water more or less in the gas holder tank.

Through a clerical error, probably, your new correspondent 'Observator' is made to propound the novel assertion that "the velocity with which gas travels through pipes is *as the square roots* of their specific gravities."—In fact the velocities are *inversely as the square roots* of the specific gravities.

J. R. S.

PORTBLE WATER FILTER.

London January 13th, 1860.

To the Editor of the AMERICAN GAS-LIGHT JOURNAL.

Sir. Seeing that your Journal is also devoted to matters concerning water, it may be perhaps of some interest for your readers to know that an apparatus in a very portable form, has recently been invented to purify water not only from all organic matters but all also from lead etc. It can be easily attached to any supply pipe, house cistern etc., and thus used at the time of drawing the water. If attached to ships-tanks pumps, the action of the pumps is only required to procure a constant stream of pure water. It is also applied in the shape of portable as well as domestic filters. It requires but little space and no clogging can take place as the impure matters are removable.

The invention consists of an artificial stone, constructed of various materials a large portion being animal charcoal and includes as well peculiar apparatus.

It has been tested by the greatest authorities and in consequence of the reports of Drs. Letheby and Lankester adopted by the London Drinking Fountain Association.

In case a party should desire to take up the invention for America and secure it by patent there (it being already secured for Great Britain), I am willing to communicate the details on moderate conditions.

I remain, Sir, your most obedient servant.
JULIUS G. DAHLKE.

Replies to the above can be addressed to Mr. DAHLKE, at Rooms of the AMERICAN GAS-LIGHT JOURNAL, New York.—[ED.

CIRCLEVILLE, OHIO, *January*, 25, 1860.

J. B. MURRAY, ESQ.,

Proprietor AMERICAN GAS-LIGHT JOURNAL:

Dear Sir—Our little works have started very nicely. We have two miles of street mains already laid, but the severe weather has been greatly against us. We have 26 public lamp posts already planted and burning, and I think we will have 150 or more private metres set up by the 1st of April.

Our works promise well, and I think will be patronized liberally. We have a neat, snug town, of about 5,000 people, well built, and wealth enough in it to support our works handsomely.

When you come out this way, come and see me, and I will take pleasure in showing you the garden of Ohio.

Our works have two benches of three retorts each—retorts iron—gas holder capacity 12,000 feet, built by R. T. Covedale, and I think he has done us ample justice in the construction of the works.

We lighted our town on the evening of January 12th.

I am greatly interested in the AMERICAN GAS-LIGHT JOURNAL, and wish you (not as an empty compliment) abundant success.

Yours truly,
W. W. BIERCE.

ANSWERS TO CORRESPONDENTS.

S. F. of Ala.—*The deodorising qualities of peat charcoal are well known. In one experiment at the Mechanics' Institute, London, related in the* Scientific Annual, *a pan of night-soil was put in a hopper with two pans of peat charcoal. The mixture was then ground in an ordinary hand-mill, after which it was examined by many scientific men, none of whom could detect the least disagreeable odor. Mr. Rogers, the inventor, offered to deliver in London the coal made from Irish peat, at $12 per ton.*

Croton, of N. Y.—*Dr. Kyan, inventor of the chemical process "Kyanizing," died in this city in 1849. He was, at the time, in communication with the Croton Aqueduct Commissioners, for purifying the water.*

B. K. of Min.—*There is no gas in Rome. Italy must make way for the pipes before long, although. We will soon tell you about Australia.*

E. D. of Del.—*We think we have said enough about coal-tar. In 1781 the Earl of Dundonnald took out a patent for collecting the tar which appeared duridg t he formation of coke. His lordship would now be entitled to a patent for getting rid of it.*

W. X. F. of Cal.—*The proper temperature of fresh air to be supplied for purposes of ventilation is 60° to 65°, and and the vitiated air, which is emitted at a temperature of 80° to 90°, should be removed by ventilators above and below.*

S. F. & Co. of Ala.—*Gas made of refuse oils and fat require less purification, because they contain less carbon and nitrogen, and more hydrogen than coal, and no sulphur. It is made in iron retorts. Booth gives the following comparative view of cannel coals and an average of several oils and fats:*

	Carbon.	Hydrogen.	Oxygen, &c.
Coal	85	6	9
Fat	80	11	9

N. D. of Md.—*Gases have different specific heats. De la Roche and Bérard show by the following table, the specific heats of some gasses with an equal weight of water* = 1000.

Carbonic acid	221·0
Oxygen	236·1
Nitrous oxide	286·9
Air	266·9
Nitrogen	275·4
Carbonic oxide	288·4
Olefiant	420·7
Hydrogen	3293·6

B. S. G. of Conn.—*Your questions are what the boys call a "stump." When we have the leisure we will answer them in fourteen quarto volumes, which is a moderate estimate of the means necessary to reply in full. Interim, we refer you to the gas books of the day.*

STERLING GAS-COAL.—Messrs. Butts & Kendall, successors to F. Butts & Co., dealers in this well known gas-coal, which is mined and sold exclusively by them, report to us a list of twenty-six Gas Companies where their coal is in use. The analysis of it can be found on page 145 of this Journal. Their certificates from several companies are to be found in to-day's issue, on the first page.

WATER-WORKS AT BROOKLYN, N. Y.

The largest pumping-engine in this country, and probably in the world, has been recently put in operation in Brooklyn, and, after a satisfactory test, has been accepted by the city. The next largest is the Leighwater engine, for draining the Harlem Meer. In actual working power the Brooklyn engine exceeds it by 16 4-10 per cent. In the Brooklyn Water Works the reservoir is in two apartments, having a joint water area of 26 acres. Its capacity is 160,000,000 gallons. It is connected with the city distribution by a three-feet main, five miles long. The engine is of the Cornish class, but different in most of its details from previous examples of the class. It is *double acting*, and works two single-acting pumps, and has a new valve-movement and other novel features.

The steam cylinder is 90 inches in diameter, with ten feet stroke; its pumps 36 inches by 10 feet stroke; its framing of cast-iron, 26 feet high from the floor; its beam cast-iron, 30 feet long, weighing 26 tons. The condenser is of the ordinary kind; the air-pump is double-acting. One pump is below the steam cylinder; its piston is worked by the steam piston-rod, descending, and connecting to a heavy cross head, which serves as counter-weight and bumper, and is fitted with slides to work an equalizing weight of 20 tons, and consists of two quadrants or quarters of wheels, on a rock-shaft that vibrates 90 degrees, throwing the centre of gravity of the mass 45 degrees to either side. In the first half of the stroke this weight is raised so that its centre of gravity is over the rock-shaft; in the last half of the stroke it descends on the other side, giving to the latest portion of the stroke the power that it had taken from the earliest portion, thus compensating for the effect of expansion of the steam. Diagrams of the pressure in the pump show a nearly equal pressure for the whole stroke. The other end of the beam works the other pump. On the rod is a counter-weight of 20 tons, which balances the steam piston, rod, links, cross-head, &c. An air-band, 8 feet diameter and 20 feet high, stands at this end of the frame; and braces from it sustain the end of the gallery. The parallel motions are on Watts' plan. The links are long, and there is no perceptible inaccuracy in the movement of the piston-rods.

The air-pump rod is on the side next the pump. On the side next the cylinder is a rod which works a frame, in slides, traveling about 5 feet. Inside this frame are cams, which give half its movement to the valve rock-shaft, the other half being given by a water-cylinder and piston, whose valves are worked from the cams. The steam piston, through the bearer, thus closes the exhaust, and opens the water-valve, which determines the admission of steam for the next stroke. On the nice adjustment of the flow of water, from the main, into the cylinder, which completes the throw of the steam valve rock-shaft, depends the accuracy of the travel of the main piston, which is such that the bumper approaches within a quarter of an inch of its seat, yet very seldom touches. The valves are balanced puppet, dropped by withdrawing a bolt; cut off at ¼ to ½ stroke. The time of cutting off is determined by a right-and-left screw, easily adjusted while at work. The steam and exhaust pipes are 20 inches and the valves 18 inches in diameter. Ten double strokes per minute is the usual speed. At this rate the motion is very accurate; no jar is produced that can be perceived by one standing in the gallery on a level with the beam. The steam pressure on the boiler is 15 to 20 pounds. The height of lift of the water is 163 feet; the pulsation in the air-barrel is about 4 pounds. The discharge-pipe is 3 feet diameter and 3,400 feet long—to the reservoir. The total weight of the engine, pumps, and all connected, is 450 tons.

The building is designed to hold four such engines, Another engine will soon be put in. It has two wings for boiler-rooms, each to accommodate six boilers, and below, one room for coal. Three boilers are now set and at work. They are cylindrical, 30 feet long and 8 feet diameter. Each has two furnaces, and each furnace two flues 20 inches diameter and 20 feet long. Each boiler has 16 return flues, 8 inches diameter, below the furnace flues; and the smoke, after traversing these return flues, descends, and passes under the shell, on its way to the chimney. The boilers are covered with felt, over which is cotton duck. Very little heat escapes—not enough to keep the room comfortable in winter. The workmanship is *good*—there being no sensible leakage of steam, either from boilers, pipes or engine. The action of the engine is almost theoretically perfect. There is no jar in stopping these ponderous masses; and the noise is merely that of the drop of the steam-valves. We often see steam-pumps of five-horse power that make more noise and jarring than are made by this enormous engine and its pumps.

As the peculiar principles of the Cornish engine are well illustrated in this example, it may be proper to mention them briefly, for the benefit of those who have occasion to use or design pumping engines.

First—The motion is slow—ten strokes per minute; the chief object is to seat the pump-valves gently; but the other moving parts are likewise benefited. The slow motion requires a large engine to do a given amount of work; and, as the momentum of the moving parts and the water equalize the motion, so as to admit of expansion to a great extent, and to avoid concussion, it is necessary that these parts should be heavy. It is for this reason that the counterweights, which might appropriately be called momentum-weights, are added to the weight of the beam, pistons, etc. And, to complete the effect, we have the equalizing weight, which resists during the first half, and helps during the last half of the the stroke. Such ponderous masses, which, in the early engines, were not easily avoidable, were until WATT's time, detrimental to the action of the engine. They caused the bumper to strike with violence at the end of the stroke, wasting the power that had been expended to generate the motion, and damaging the machine by the concussion. To relieve the engine from these evils WATT cut off the power before the end of the stroke, leaving the motion to subside so that it would cease at the proper point without concussion. He found that when the steam, instead of being admitted during the whole stroke, as had been the practice, was cut off at the first quarter, the usual work was done and three-quarters of the steam was saved. In later engines, working at higher pressure, the steam is cut off at one-sixth; and the moving masses are purposely made heavy, so that the strong steam may exert its power upon them without producing too much speed, and so that the speed produced may not too soon diminish in consequence of the weakness of the expanded steam. Thus the heavy masses serve the purpose which the heavy fly-wheel serves in the common engine—they equalize the speed, and prevent jerks and collisions. In the Brooklyn engine this is effected so fully that the bumper seldom touches, and seldom falls a quarter of an inch short, so that very little power is lost either by pounding the guard-block, or by loss of steam in the clearance between the piston and cylinder-head.

Second—The air-chamber of this engine has a very useful effect. The delivery-pipe being 3,400 feet long and 3 feet diameter, the weight of the mass of water flowing in it is 1,500,000 pounds, at the speed of 3½ feet per second. To stop this mass would require a power sufficient to lift 2,600.000 pounds, 1 foot high; it would not stop, but would continue to flow, drawing after it the water in the pump below the bucket, so that the valves would not drop into their seats at the proper time, but would strike violently after the commencement of the stroke. The elasticity of the air in the chamber reduces this evil, so that the beat is harmless. It has been still further reduced by placing in the air-chamber a diaphragm, having valves to allow a free upward movement of the air, but to throttle its return. This refinement eased the valves by retarding their descent; and by diminishing the pressure in the water-engine, which completes the throw of the steam valves, it caused a greater pause at the end of the stroke. But it wasted the power accumulated in the air by compression, and partially restrained by the throttling, to such extent that the mean pressure of steam had to be increased from 11,875 to 13,075 pounds per inch.

Third—There is an important distinction between the action of the Cornish engine and the crank and fly-wheel engine—which was among the plans proposed for these works. The crank gives to the piston a motion that does not accord with the easiest motion of the water, but the Cornish engine has its motion controlled by the flow, and the momentum of its parts, and thus it follows the water, without too much straining at one time and too little pressure at another. A long experience, in mines and other places, has established the Cornish principle as most favorable to the unrestrained flow of the water, on which economy of power depends, and to the smoothness of action, on which durability of the machinery depends.

Fourth—In this engine there is a novel arrangement of the pumps, which, the builders believe, contributes to the result they have attained. Each pump, 36 inches in diameter, is placed within a cylinder 54 inches in diameter. The buckets of the working-barrel are fitted with double-heat covers working on the pump-rods; and double-heat covers or valves are also fitted on the annular spaces between the working-barrel and the external cylinder. The lower 36-inch bucket delivers through the barrel above it, and also through the 54-inch barrel; and the upper bucket draws its charge through both a 36-inch and a 54-inch barrel, It is considered that this arrangement involves less friction than the ordinary arrangements.

A trial was made on the 12th to 14th January, which lasted 26 hours and 3 minutes, during which time 34,753 pounds of coal were burned, and 1,943,802 cubic feet of water were pumped to a height of 160 feet. The friction, leakage, &c., in the pumps and delivery pipe were computed to raise the work to 1,999,349 cubic feet, lifted 170 feet high, which is equal to 21,243,083,040 pounds lifted one foot by 34,763 pounds of coal, or 611,083 pounds lifted one foot by one pound of coal.

The average duty of one of the Cornwall engines for three months was, 1,494,000 pounds of water lifted one foot by a pound of coal. The tests, however, had been made on a somewhat different basis—favorable to the Cornwall engine. The Brooklyn engine does more than the required duty, under less advantageous circumstances, and in many particulars is a decided improvement upon the old plans.

A subsequent capacity test showed the engine capable of delivering 15,532,066 gallons in twenty-four hours. The average speed was 10.29 strokes per minute. When the four engines are completed, the city may receive 62,000,000 gallons per day.

The Chief-Engineer of the Water Works, is James P. Kirkwood. Samuel McElroy, is principal Assistant-Engineer of engine-house, pumping machinery, and reservoir. William Wright, a mechanical engineer of well-known ingenuity, superintended the construction of the engine at the works of the builders, Messrs. Woodruff & Beach, of Hartford, Conn.

THE AMERICAN PUMP.—Mr. J. M. Edney advertises his great American Pump, in to-day's issue. It is like a two-edged sword; it works both ways, and the amount of water it drives up is surprising. The certificates in its favor are too numerous to mention.

INUNDATIONS.

BY M. VALLES,

Ingénieur-en-Chef des Ponts et Chaussées.

(From *Les Nouvelles Annales de Construction*, April, 1859.)

After the disasters caused by the floods of 1856, the government authorities instituted, on a wide basis, a special commission on inundations which was charged with the duty of investigating in all its bearings the complicated question as to what means should be adopted to prevent the recurrence or to diminish the severity of these dangerous phenomena.

To transform into powerful fertilizing agents the waters which so frequently devastate our plains—to secure, at all times, a safe navigation on the most variable streams—to convert into an abundant and regular source of motive power those storm-waters which continually menace our great centres of industry—in a word, to make of an enemy, frequently so terrible, a valuable friend to all our labors, and a tractable assistant in our agriculture and our manufactures—such was the object to be attained by this enquiry. Never was a problem more elevated in character, or of greater importance to the national wealth, submitted to the consideration of the engineers, agriculturists, and philosophers of a great country. It is to be hoped that the disasters of 1856 will not be forgotten, like those of 1846 were. Preventive works will, it is to be hoped, no longer remain in the form of projects or of indefinite phantasies.

The management of water, with especial reference to agriculture and inundations, must therefore be, at the present day, the great study of engineers, and of all enlightened men; each should contribute the quota of his abilities, ideas and experience, to this great undertaking. M. Valles was one of the first to respond to this call. Having prepared himself for his work by his previous studies, he was enabled, in the month of December, 1856, to present a manuscript of his memoir to the meeting convened by the *Académie de Bourdeaux*.

M. Manès, *Ingénieur-en-chef des Mines*, reporter of the committee appointed to examine the papers, expressed his opinion of the important memoir under consideration in the following terms:

"The memoir No. 791—the most voluminous and the best of all—is a true exposition of the subject, in which are described with the greatest care the phenomena of rain, tides, methods of preservation, ways and means. There is nothing in it vague and indefinite; every assertion it contains is confirmed by examples; every idea put forth is accompanied by corroborative facts. This exceedingly well written memoir is remarkable for high philosophical considerations. It must have required an immense amount of research, and bears witness in all its parts to the profound erudition of its author." An enumeration of the principal divisions of the memoir of M. Valles will enable us clearly to understand the course he has taken, and the importance of the subjects treated of.

The two first chapters are devoted to the phenomena of rain, and to the consideration of the permeability of strata. The author details in the most complete manner many facts not generally known; and deduces, by comparison, many general considerations of great importance. The third chapter treats of the tides, their advantages and disadvantages. The fourth chapter is devoted to the demonstration of the dangers attending the use of insubmergible longitudinal embankments. The development of the principal ideas of the author as to the means to be employed in order to mitigate the ruinous effects of floods and to secure the advantages to be derived from them, occupies the fifth chapter. Reservoirs and transverse weirs appear to M. Valles to be the proper basis of every efficient system. He gives, besides, a detail of the observations required in order to obtain the necessary data for calculating the dimensions of these works, for we are far from possessing the information necessary for the preparation of general and definite projects. The 6th chapter contains a remarkable dissertation on the principal systems which have been proposed to counteract these floods. Some of the author's conclusions may, perhaps, be criticized, but even his opponents will find in his work the best collection of information necessary to the subject under discussion. Finally, the memoir concludes with estimates of the cost of the works proposed, and a consideration of the steps to be taken to cover it. The author has taken the basin of the Loire as an example of the application of his scheme. He estimates the outlay required in its execution at £2,800,000; and he conjectures that five times that amount would suffice for the protection of the whole of France from the consequences of floods.

One general idea predominates throughout the memoir of M. Valles, and appears more strongly supported in each succeeding page; and that is, the intimate connexion between the agricultural question and the problem of the inundations—the indispensable necessity of keeping in view the two subjects in all our operations, and combining unceasingly the investigations of the hydraulic service with those relating to the floods. The works designed to prevent the disasters occasioned by the floods should therefore, at the same time, effect the irrigation and the dressing of the arable lands. The importance of these agricultural operations is clearly demonstrated by the author.

M. Valles insists, with great justice, and more earnestly than is generally done, on the fertility of the mud carried down by our rivers in the time of floods, and on the immense value of the products of that kind carried down and at present lost in the sea. But still, perhaps, he does not insist with sufficient weight on the actual amount of their value. Unfortunately we have not at hand the necessary elements for the complete consideration of the

question, but a single item will prove that the subject is deserving of especial consideration. It is generally admitted that the Garonne, in time of high flood, brings down 10,000 mètres cube, and that its waters contain three kilogrammes of mud per mètre cube. These data, in conjunction with the analysis nf the mud, enable us to calculate that the river brings down in 24 hours a quantity of fertilizing matter containing 5,184,000 kilogrammes of nitrogen, that is to say, as much of that element as would be found in 34,560 tons of Peruvian guano—nearly the total amount of the annual importation of that substance into France.

Thus, one of our rivers (the muddiest, it is true) brings down to the sea, every day of high flood, the value of 8,000,000 frs. or 10,000,000 frs. in excellent manure. The mud of the Loire, although, indeed, much less abundant, is still richer in nitrogen. Reduce the foregoing quantity as much as you will, so as to allow for any possible exaggeration in the computation of the amount brought down or the number ot the floods, and. although it is not possible to retain the whole ot the mud, still the fact remains established, that the floods deprive our agriculture of a quantity ot fertilizing matter, whose value ought in evey project to be taken into very serious consideration.

NEW AQUEDUCT BRIDGE AT WASHINGTON, D.C.

Among the public works now in course of completion at Washington, is the Aqueduct Bridge over Red Creek, at the western end of Pennsylvania avenue. This bridge is a cast iron arch of 20 feet rise and 200 feet clear span between the abutments. The arch consists of two ribs, each of which is composed of 17 cast iron pipes of 48 inches internal diameter, and 12 feet 3 inches in length. They have flanged ends pierced with holes for screw bolts, by which the pipes are firmly connected together. After being cast, they were placed in a lathe, and the ends and flanges were accurately turned or faced off. They are put together in the form of a circular arc, the faced ends abutting against each other, and 40 screw-bolts firmly secure each joint. Such is the accuracy obtained by the present use of machinery in engineering, that these joints are water-tight, under the aqueduct pressure of 120 feet head, by mere application of the dressed surfaces of cast iron, no packing or cement being used in the joints.

Upon these two arched ribs, which are firmly connected with each other by cast iron tubular crossbraces and heavy wrought diagonal ties, is erected a framework of heavy rolled iron "H" beams (from the works of the Phœnix Iron Company of Philadelphia), supporting two continuous horizontal iron girders, 204 feet 6 inches in length. Upon these girders rest crossbeams of timbers, supporting the roadway of the bridge, which embraces two city railroad and carriage tracks, and two paths for foot passengers.

The cornice of the bridge is decorated with modillions of cast iron, and a light wrought iron railing surmounts the whole.

The abutments, founded upon solid rock, are built in the most substantial and durable manner, of a fine gray sandstone, obtained in large blocks from the government quarries at Seneca, upon the Chesapeake and Ohio Canal, 24 miles from the city of Washington. The strength of the stone is 17,000 pounds per square inch.

This bridge is particularly remarkable for the double duty which the arch performs. While it supports a roadway, forming a beautiful and much-needed communication, by which the traffic between the cities of Washington and Georgetown is carried over, the water of the Washington Aqueduct is carrried into the city of Washington through the pipes of which the arch is composed. To guard against all danger of freezing, the pipes are lined with staves and resinous pine timber, three inches in thickness, leaving a clear water-way in each rib of three and a half feet in diameter.

The flanges and bolts by which the pipes are connected at the joints are covered with decorative mouldings, encircled with foliage of cast iron. The arch ribs spring from ornamental bases, which distribute the pressure over huge blocks of granite set in the skew back of the abutments. The intersections of the beams in the framework of the spandrils are covered with ornamental bosses, also of cast iron. The whole is a model of lightness and elegance, being 200 feet in clear span, and 45 feet in hight from the water to the top of the parapet.

The abutments contain vaults, in which are the connecting pipes and stop-cocks for regulating the flow and discharge of water; and in the western abutments on the Georgetown side, one of the vaults serves as an engine-room and contains a water-pressure engine—the first, it is believed, erected in this country.

The engine, drawing its supply from the cast iron street mains of the Washington Aqueduct, pumps 10,000 gallons of water per hour into a reservoir on the hights of Georgetown, a mile distant, and 204 feet above the machine. This reservoir supplies that portion of Georgetown which is above the level of the great store and distributing reservoirs of the Washington Aqueduct. In a recent experiment, the engine, using 10,862·2 gallons of water per hour, under the effective pressure of 99·86 feet as power, pumped 10,410.4 gallons of water against an effective head or resistance of 90.245 feet. This gave an useful effect of 866 of the power employed; the loss being absorbed in friction, in producing motion of the parts of the engine and of the water and in leakage, the latter alone beiag about 2½ per cent. of the water used. By the formula given by Wiesbach for the efficiency of the engine alone, the efficiency of the engine and pump being considered equal, 12½ of the total loss of effect being due to the motor, the efficiency of the motor here used is 933, a very high result. The engine and pumps were built by H. B. Worthington, of New York city, under his patent of 1855.

The Washington Aqueduct has other works not less remarkable than the one described; among them, the great granite arch, by which the masonry aqueduct, nine feet in diameter, crosses the Cabin John Creek, at a hight of 101 feet above the bed of the stream. The arch is built of huge granite, is 20 feet wide, 57 feet 3 inches rise, and, being 250 feet in clear span, is the largest stone arch in the world.

SANITARY ARRANGEMENTS.

WATER-CLOSETS.

Plumbers, architects, builders, and others interested in the erection of dwellings, will find in the pages of this Journal that their interests are not overlooked, but that as often and as fully as space permits, information will be introduced likely to prove of practical value to them. The sanitary advantages of any house will usually be in proportion to the sanitary knowledge and scientific skill possessed by those who have erected it. And as the health of towns depends so largely on the healthfulness of its houses, the importance is apparent of spreading accurate knowledge on this subject.

At present we propose to offer a few simple facts relative to water-closets, and the best method of preventing them from becoming offensive, miasmatic, and pernicious.

The best position for a water-closet in any building, is that in which all the waste water shall be made use of in scouring the contents directly through the pan of the closet, and propelling them forward through the private drain into the common sewer. And since, if the house drain is reserved for its proper uses, the discharges into the closet will be more solid and less readily conveyed than the other sewerage matters, it will, moreover, be desirable to place the closet as near as posible to the point at which the drain discharges into the sewer. The velocity and force of the liquid sewerage are increased at the lower or sewer end of the drain, and its effect is thus augmented in scouring away the contributions of the closet. But if this preferable position cannot be commanded for the closet, it must at any rate be so situated with regard to the head of the drain and the inlet for the liquid sewerage, that these shall be behind or above it. When the closet and the house-sink are near to each other, the water from the latter may be conducted directly into the trap or basin of the closet, and thus secure at once a rapid discharge of its contents and a constant supply of liquid to preserve its action and efficiency.

The position of the water-closet being determined, it becomes desirable to select the most economical and efficient construction for it, and for the apparatus connected with it.

Prof. Alfred Post, of New-York University, mentioned at the last meeting of the Sanitary Association, a method which he had found completely successful in carrying off the offensive vapors from the chambers of water-closets. The plan consisted in fitting a pipe to the chamber and carrying this pipe above the roof of the house. The Professor stated, that this expedient had been adopted in his own house and in those of several of his friends, and had in every case operated very satisfactorily.

The head of the drain, and every inlet to it, require, to be fitted with a trap to prevent the escape of effluvia and this will equally form an indispensable part of the closet apparatus. The perfect action of the trap will demand a means of supplying water on each use of the closet, and although all possible advantage should be taken of the house-sewerage water in promoting the action of the drains, a separate and constantly commanded source should be provided for this purpose. If the supply of water to the house or building be rendered upon the constant service system, a mere tap will be sufficient to afford the means of discharging a volume of water through the trap of the closet. If the water be supplied upon the intermittent system, a cistern or reservoir of some kind, provided for the house supply, must be made to communicate with the pan of the closet by a pipe with a valve and apparatus for working it. For general use it is especially desirable that economy and simplicity be combined in the whole of the apparatus of the closet. Delicacy of adjustment, requiring a complicated arrangement of the parts, and a corresponding costliness of construction and repairs, and carefulness in management, is inadmissable in a design adapted for general adoption; and combinations of levers and cranks, liable to accidental derangement and injury by roughness of treatment, are therefore to be avoided as much as possible. The position of the cistern in relation to the closet will affect in some degree, the force and efficiency of the volume of water discharged on each occasion; and if the supply of water to the building be constant, the service pipe should be so conducted over the closet that the tap can be conveniently placed for admitting the required quantity to the pan. If the supply is obtained from house-cistern, this must, of course, be placed above the pan, and at such elevation that the water may acquire a sufficient impetus to flow with rapidity.

Glazed stoneware basins or pans, with syphon-traps combined, are the most economical and effective for general purposes. These are made in several forms, viz.: with the pan and trap in one piece, and adapted to communicate either with a vertical or horizontal drain; with a separate trap, having a screwed socket on the head in which the lower part of the pan is received, being formed with a collar and screwed end; or, as a somewhat more complicated arrangement, consisting of a trap with a flanged head and separate dip pipe having a projecting flange about its mid-length, and a spreading mouth above, into which the lower part of the pan is fitted with cement. The dip pipe, extending downwards into the trap, below the level at which its contents flow out, is secured to the head of the trap by bolts passing through the holes in the flanges. The reason for making the pan separate from the dip pipe would appear to arise from a difficulty in forming them together with the wide projecting flange so as to give sufficient steadines to the pan above. This latter form was designed especially for prison use, under circumstances which do not allow of any fixed seat or framing above to which to secure the pan. The previous forms are found to answer all purposes in cases where this kind of support is afforded, and are preferable for their fewer number of parts. The pan in each of these forms of construction is provided with an aperture and inlet at the upper part, having a socket to receive the water-pipe.

The combined arrangements for efficient house-drainage comprise, besides the means of adequate water supply, the water-closets, house-sinks, and drains in which the matters committed to the closets and sinks are conveyed and delivered into the public sewers. And if the rain-water falling on the roof of the building and on the yard or space attached to the house, is not applied to any other purpose, it will have to be conducted into the drain to be discharged with the sewerage. These waters being the purest of the contents should be received as near as possible to the head of the drain, and made to traverse its entire length, and thus exert all the cleansing action of which they are capable. The house sink or place at which the ordinary waste water of the household is discharged should communicate with the drain at a subsequent part of its course, and the closet be so placed that its contents shall traverse a minimum portion of the drain, thus reducing the liability to the escape of effluvia, and deriving the greatest scouring force from the accumulation of the rain and house waters. The drain being formed as a complete and impervious channel receiving the entire sewerage and waste waters of the premises, made easy of access and examination, and provided with traps at every opening or inlet for receiving the drainage, may be graduated in size from the one extremity to the other, and if of considerable length, it may be provided at intervals with self-acting valves or traps to prevent the possible return of any matters, waters, or gases, from the lower towards the upper end.

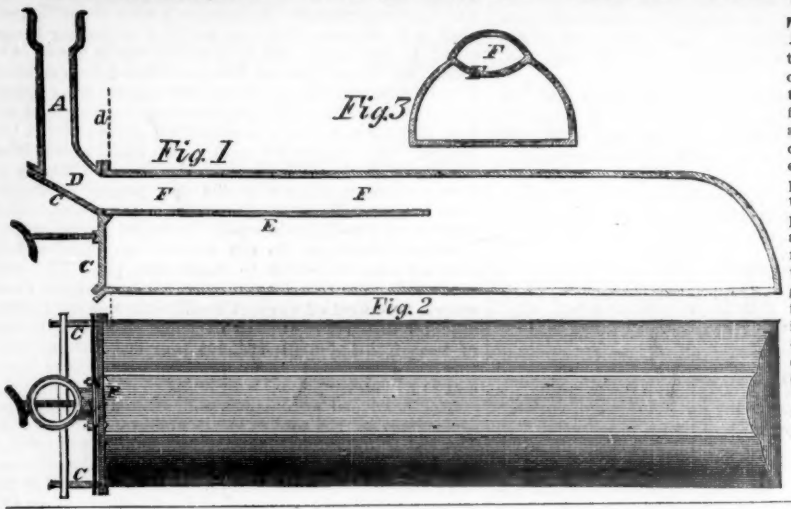
Self-acting valves or traps are constructed of the stoneware; and the valves being hung at a slight inclination, and well fitted with a rim at the meeting surface, they remain closed against any retrogade movement of the sewerage or gases, but are readily opened by a slight force of water in the outward direction of the drain. Sink traps are also formed of this material, with perforated heads or covers, and syphon bends below, which remaining filled with the drainage water, prevent the escape of any effluvia from the drain into which they give access.

Beside the socket drain-pipes of glazed stoneware whichwe have described, another material, known under the name of "Terro-metallic," has been applied in the production of a superior quality of piping, which is manufactured in cylindrical forms both with socket ends and plain butt ends, and also in a conical form with plain ends, the cones fitting one another so that the joints are similar to conical socket joints, and may be made to fit with a great degree of exactness. The material of these pipes is of the same quality as that used in making fire-bricks, and has an extreme density with a very durable glaze upon the surface.

Although complexity of parts is to be avoided in water-closets intended for use in the greater number of dwellings, some of the more complete forms of apparatus adapted for self action, and which necessarily comprise considerable detail of arrangement, are preferable in superior buildings in which close economy of construction is not a first condition, and regular care and attention can be secured for the action of the apparatus employed.

In some of these closets, the valve which opens and closes the opening into the water-pipe is attached by a rod to a lever, which, by means of a cord or chain, is connected with the door of the closet, so that the opening of the door opens the valve and thus discharges a quantity of water into the pan. In another form of apparatus, the pressure of the person upon the seat prodces a similar effect. Among the most improved of these is one patented in England, by Messrs, Bunnett & Co. This closet is self-acting and doubly trapped, and designed to secure a supply and force of water which shall always be efficient and uniform without waste. It is, moreover, so contrived, that no soil can remain in the basin after use, and an ample supply of water being secured in the basin so as to form a water-lute between that and the syphon-trap, the rising of smell is effectually prevented. The lower part of the pan dips into a water-pan or trap, which is hinged and maintained in a horizontal position by a rolling balance weight. The effect of pressure on the seat of the closet is to depress a lever and open a valve in the supply-box of the cistern, and thus pour a volume of water into the water-pan or trap sufficient to throw it open, and thus afford a passage for the soil into the lower basin, which terminates in a syphon and is also trapped with water. When the pressure is removed from the seat, the water-pan or upper trap is immediately brought back to a horizontal position by the rolling weight, and receives sufficient water before the closing of the valve, to fill it, and thus effectually shut off all communication with the lower basin.

SYMMES PATENT GAS-RETORT.



THIS cut represents a new mode of connecting retorts to the "stand pipes" without using "mouth-pieces," thus saving the drilling the flanges and making the joints, as well as some 250 lbs. of casting, and several bolts for each retort set. A narrow piece of the door, C, closes the lower end of the stand pipe. The plate, E, is a separate piece, thinner than the retort, and may be secured to the door, C, or slid over grooves made in the retort for that purpose. The retort is set in the ovens to the dotted line, *d*. This mode of connecting may be applied to Clay as well as iron retorts.

For information concerning the above, or for the castings. Address

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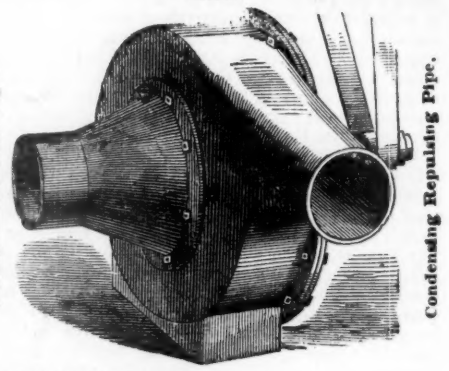

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Fig. 1 is a perspective view, and Fig. 2 a section of the working parts, which I will now proceed to explain.

The Pump is attached to a board or scantling, A, secured to the sides of the well or otherwise, as may be desired, and is worked by a handle to which, at equal distances from the center, two rods, F, are connected by a turnbuckle, their other ends being connected to the moving lever, E, of the Pump, which works on a pin, G. This lever, E, is T shaped and moves through a space, I, in the air-chamber, H, cast to receive it. The pump-barrel, B, has closed ends, D, and the double piston, C, with its valves, J, works horizontally therein. KK are the valves of the air-chamber. The operation is as follows:

The Pump is immersed in water and the handle being given a reciprocating motion the T-piece, E, receives a similar one through the rods, F. This gives the piston a horizontal, back and forth motion, at each of which it takes in a quantity of water and forces it into the air-chamber, and thence through the pipe upwards to any hight. To this pipe a hose is here attached to show how it throws water. &c.

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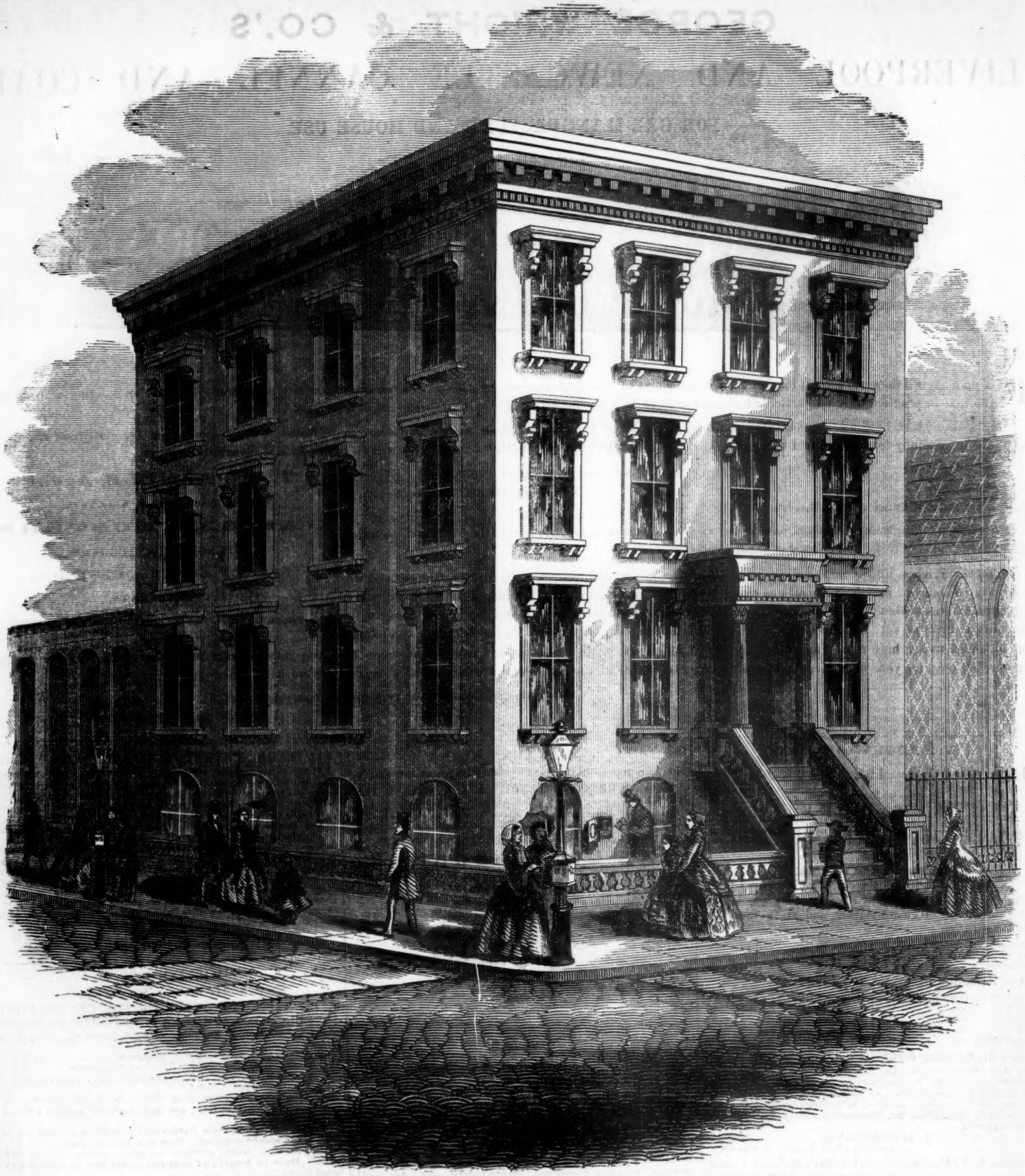

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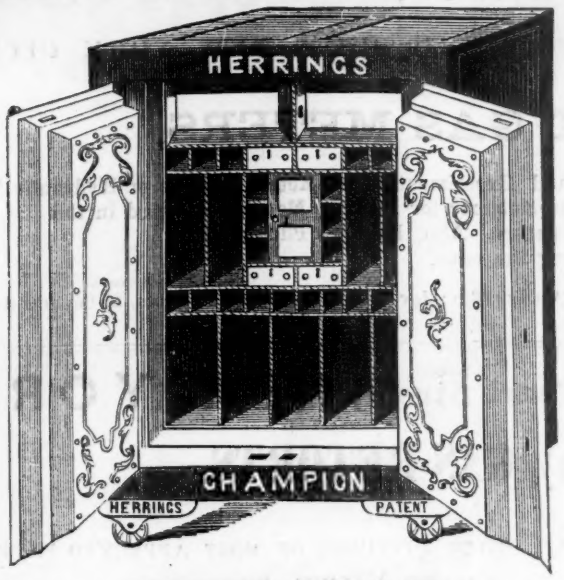

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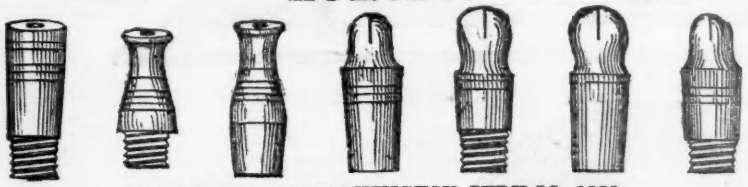

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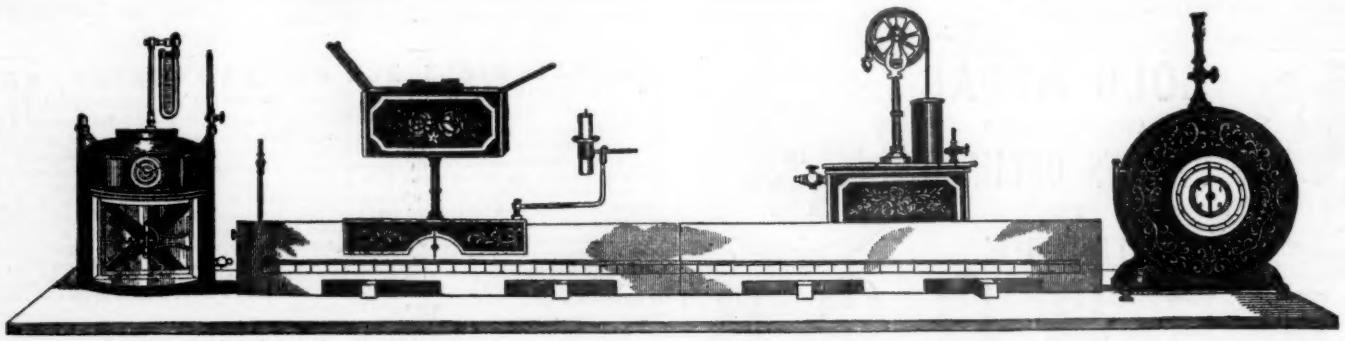

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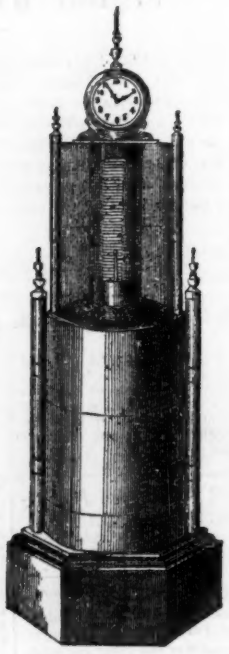

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